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# TAXONOMY AND BIOLOGY OF PHLEBOTOMINE VECTORS OF HUMAN DISEASE

FINAL REPORT

D. G. YOUNG

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A taxonomic review of the Lutzomyia sand flies occurring from Mexico southwards was completed. The treatment of the 362 species and subspecies includes identification keys, distribution maps, illustrations (280 plates) and over 700 references. Seventeen new taxa are illustrated but not named. A summary of other work on the biosystematics, biology and disease relationships of Phlebotominae is given. Keywords:

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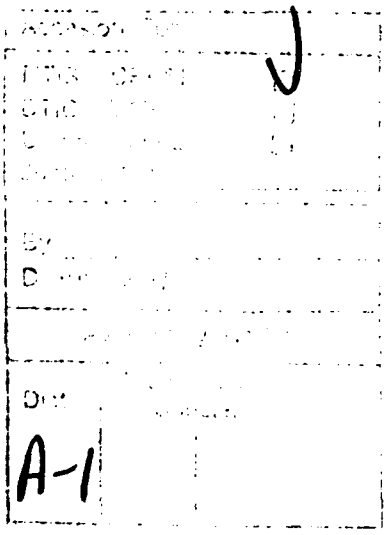
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## Introduction

This report covers the period from Sept. 1, 1982 to Dec. 31, 1987. During this time major efforts were made to compile a taxonomic review of the New World phlebotomine sand flies and to study their biology and disease relationships.

## Objectives

1. To study the taxonomy of sand flies from the Neotropical Region, with special emphasis on the fauna of Mexico and Central America, and to provide a handbook on the entire fauna.
2. To study the taxonomy of sand flies from Africa and the Near East, providing identification keys, reference collections (based mainly on newly collected material); and to evaluate future needs for study in these areas.
3. To colonize, in the laboratory, different species of Phlebotominae from Africa, the Near East and the Neotropical Region, with special emphasis on vector species.
4. To assess the susceptibility of colonized species to aetiologic agents of disease.

## Results

1. A taxonomic review of the Lutzomyia sand flies of the neotropics and southern nearctic region was completed (Appendix I). This guide, or handbook, treats 362 species and subspecies. Information

is given on their medical importance, geographic distributions, habits and identification.

This information was compiled from both published ( 700 references) and unpublished sources. The majority of illustrations, shown on 280 plates, was based on actual specimens whenever possible. There has been no comparable treatment of the New World sand flies since Forattini's book (in Portuguese) was published in 1973. Furthermore, approximately 50 additional species have been described since 1973 and this fact, among other reasons, makes the 1973 book out-of-date. The major objective under this contract was to compile such an up-to-date review of the neotropical sand fly species.

2. Other research related to sand fly biosystematics resulted in the following publications. Full citations are given on pages 7-11.

   A. Faunal Studies (most include descriptions of new species)

      - North America (Young & Perkins 1984)
      - Ecuador (Young & Rogers 1984)
      - Peru (Young et al. 1985)
      - Suriname (Hudson & Young 1985)
      - Colombia (Young & Morales 1987)

   B. Descriptions Of New Species and Reviews

      - Lutzomyia zeledoni (Costa Rica & Honduras) Young et al. (1984)
      - Lutzomyia guatemalensis (Guatemala) Porter & Young (1986)
      - Two new Sergentomyia spp. were discovered in Tanzania by D. Young. They will be described and named in a forthcoming article.

- A taxonomic review of the microps species group of Lutzomyia was published (Young & Arias 1985). Lutzomyia nematoducta from Brazil and L. preclara from Peru were described for the first time.

C. Genetic Studies

Two studies dealing with sand fly karyotypes were completed. This is a little-known subject; previous work had been done only with the chromosomes of one species, L. longipalpis. Brain cell karyotypes of 12 phlebotomine species (Lutzomyia and Phlebotomus spp.) differed morphologically and numerically according to species (Kreutzer et al. 1987; 1988 in press).

The Lutzomyia (verrucarum group) spp. are medically important in South America with 4 species, at least, considered suspect or proven vectors of cutaneous leishmaniasis. The females of some of these are morphologically inseparable. Therefore, the PI in collaboration with colleagues in Venezuela, Colombia and North America initiated an isozyme study as a way to better understand the relationships of 10 verrucarum group species, including all of the 8 species in the townsendi complex. Adults of these taxa were collected from type localities in Venezuela and Colombia, frozen in liquid nitrogen, then analyzed by electrophoresis. Genetic characterization suggested that 3 of the named species, L. sauroida, L. longiflocosa and L. quasitownsendi, are conspecific; whereas the other 7 taxa have diverged to a much greater degree. This

study (Kreutzer et al. 1989, in press, J. Med. Entomol.) represents the first attempt to analyze a species complex of Phlebotominae by such methods.

3. Biological Studies

Rearing methods for sand flies, developed by the PI and students, were effective for maintaining species of African and New World phlebotomines (e.g., Beach et al. 1984, 1986; Lawyer et al. 1987). The laboratory biology of L. anthophora was carefully studied by Endris et al. (1984). Such laboratory colonies provided information on autogeny (Young & Perkins 1984) and overwintering or diapausing stages (Young & Lawyer 1987).

Biological studies in the field resulted in a paper on the flight ranges of several Lutzomyia spp. in a Colombian focus of Leishmania braziliensis (Alexander 1987). Other, as yet unpublished, information from field studies in Colombia and the Dominican Republic was obtained.

4. Sand Fly-Borne Pathogens

A. Arboviruses.

Endris et al. (1983) demonstrated transovarian transmission of a Phlebovirus (Rio Grande Virus) for the first time under experimental conditions. This virus infects Neotoma woodrats and is known to occur only in southern Texas.

The PI collaborated with colleagues in Colombia where at least 6 new arboviruses were isolated from phlebotomines (Tesh et al. 1986 & unpub. data). In addition, a vesicular

stomatitis virus (Alagoas virus) was also isolated from phlebotomines from Colombia. Previously, this virus was known only from Brazil in infected livestock.

B. Leishmania

Young & Lawyer (1937) reviewed published and unpublished information on New World vectors of the leishmaniases. Vector competence studies carried out in Gainesville included those by Lawyer & Young (1987), Lawyer et al. (1987), Endris et al. (1987) and Johnson (1984, unpub. data using L. christophei and Leishmania from the Dominican Republic).

Dissections of Colombian sand flies, previously frozen in liquid nitrogen, following the methods of Young et al. (1987), were made from 1984-1987. This work was partly supported by the present contract and by NIH. Isolations of Leishmania braziliensis and Leishmania guyanensis were obtained from naturally infected L. spinicrassa and L. umbratilis, respectively (Young et al. 1987).

A new Leishmania parasite in the braziliensis complex was isolated from L. hartmanni by the PI in 1987. The flies were captured in Santander Dept., Colombia. Experimental feedings of other Lutzomyia spp. supported the placement of this Leishmania in the section peripylaria (Young et al., unpub. data). Following further characterization, this new parasite will be described and named.

5. Publications Resulting From This Research


- Alexander, J.B. 1987. Dispersal of phlebotomine sand flies (Diptera: Psychodidae) in a Colombian coffee plantation. J. Med. Entomol. 24: 552-558.

- Beach, R.F., D.G. Young & G. Kiilu. 1986. New phlebotomine sand fly colonies. II. Laboratory colonization of Phlebotomus duboscqi (Diptera: Psychodidae). J. Med. Entomol. 23: 114-115.

- Beach, R.F., D.G. Young & M. Mutinga. 1984. Laboratory colonization of Phlebotomus martini Parrot 1936 (Diptera: Psychodidae), a vector of visceral leishmaniasis in Kenya. J. Med. Entomol. 20: 579-584.

- Christensen, H.A., G.B. Fairchild, A. Herrer, C.M. Johnson, D.G. Young & A.M. de Vásquez. 1983. The ecology of cutaneous leishmaniasis in Panama. J. Med. Entomol. 20: 463-484.

- Endris, R.G., R.B. Tesh and D.G. Young. 1983. Transovarial transmission of Rio Grande virus (Bunyaviridae: Phlebovirus) by the sand fly, Lutzomyia anthophora. Am. J. Trop. Med. Hyg. 32: 862-864.

- Endris, R.G., D.G. Young & J.F. Butler. 1984. The laboratory biology of the sand fly, Lutzomyia anthophora. J. Med. Entomol. 21: 656-664.

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- Endris, R.G., D.G. Young & P.V. Perkins. 1987. Ultrastructural comparison of egg surface morphology of five Lutzomyia species (Diptera: Psychodidae). J. Med. Entomol. 24: 412-415.

- Hudson, J.E. & D.G. Young. 1985. New records of phlebotomines, leishmaniasis and mosquitoes from Suriname. Trans. R. Soc. Trop. Med. Hyg. 79: 418-419.

- Kreutzer, R.D., G.B. Modi, R.B. Tesh & D.G. Young. 1987. Brain cell karyotypes of six species of New and Old World sand flies (Diptera: Psychodidae). J. Med. Entomol. 24: 609-612.

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- Lawyer, P.G., D.G. Young, J.F. Butler & D.E. Akin. 1987. Development of Leishmania mexicana in Lutzomyia diabolica and Lutzomyia shannoni (Diptera: Psychodidae). J. Med. Entomol. 24: 347-355.

- Porter, C.H. & D.G. Young. 1986. A new species of phlebotomine sand fly (Diptera: Psychodidae) from Guatemala. J. Med. Entomol. 23: 236-243.

- Schaer, M., D.J. Meyer & D.G. Young. 1985. A dual infection of Leishmania donovanai and Ehrlichia canis in a dog. Comp. Cont. Ed. 7: 531-534.

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Young, D.G., J.E. Perez & G. Romero. 1985. New records of phlebotomine sand flies from Peru with a description of Lutzomyia oligodonta, n.sp. from the Rimac Valley (Diptera: Psychodidae). Int. J. Entomol. 27: 136-146.

Young, D.G., A. Morales, R.D. Kreutzer, J.B. Alexander, A. Corredor, and R.B. Tesh. 1987. Isolations of Leishmania braziliensis from cryopreserved Colombian sand flies (Diptera: Psychodidae). J. Med. Entomol. 24: 587-589.

APPENDIX I

# GUIDE TO THE IDENTIFICATION AND GEOGRAPHIC DISTRIBUTION OF LUTZOMYIA SAND FLIES IN MEXICO, THE WEST INDIES, CENTRAL AND SOUTH AMERICA (DIPTERA: PSYCHODIDAE)

DAVID G. YOUNG

&

MARGO A. DUNCAN

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# PART I

## INTRODUCTION

The phlebotomine sand flies are notorious vectors of pathogens causing the leishmaniases, bartonellosis and several arboviral diseases. Available evidence indicates that the medically important species belong in two genera -- Phlebotomus Rondani & Berté (Old World) and Lutzomyia Franca (New World). Members of the former genus were reviewed taxonomically by Lewis (1982), but there has been no comparable treatment of the Lutzomyia sand flies since Forattini's volume was published in 1973 (in Portuguese).

Accordingly, we felt that an up-to-date account of the Lutzomyia species and subspecies might be useful to investigators who are interested in studying these hematophagous insects. The North American sand fly fauna of 14 Lutzomyia species was reviewed recently by Young & Perkins (1984). Five of these are known only within the continental boundaries of Canada and the U.S.A. and are excluded in the present work -- L. californica (Fairchild & Hertig), L. apache Young & Perkins, L. aquilonia (Fairchild & Harwood), L. tanyopsis and L. xerophila Young, Brenner & Wargo. Similarly, fossil species, such as L. paterna (Quate) from Mexico and two undescribed Lutzomyia spp. from Dominican Republic amber (Young & Lawyer 1987), are not included.

The present review covers Lutzomyia species and subspecies occurring in Mexico, the West Indies, Central and South America. Emphasis is placed on their identification and geographic distribution. Barretto (1947a) provided complete references to these, and other, topics related to sand flies

described before 1947. Subsequent articles, including those by Fairchild & Hertig (1947-1961), Forattini (1973), Martins et al. (1978) and Young (1979), contain additional citations. These papers, and others listed here, can be consulted to give a complete or nearly complete, bibliography for each taxon, including immature stages which are not treated in the present review.

We have examined 26 undescribed Lutzomyia spp. from the neotropics, 17 of which are illustrated and keyed in the following pages. However, these species will not be formally named until fully described elsewhere by us or colleagues.

The distribution maps were prepared from both published and unpublished information. The book on American sand flies by Martins et al. (1978) gives detailed locality information and has made our task of plotting the geographic ranges of many species much easier. Doubtful records are marked with a query and are discussed in the text. Each symbol on the map represents one or more specimens from, or near, a specific locality.

The majority of illustrations are original or were published previously by the senior author alone or with co-authors. It was necessary to adapt some figures of sand flies from the literature when specimens were not available. References to these illustrations are given where appropriate.

The search for new taxonomic characters has been accelerated, especially as they relate to cryptic species which are inseparable in structure or coloration. For example, differences in cuticular hydrocarbons were noted between the structurally-similar females of L. wellcomei and L. complexa in

Brazil (Ryan et al. 1986c). Earlier efforts to distinguish these cryptic females by multivariate discrimination were not completely reliable (Lane & Ready 1985). The increasing use of enzyme electrophoresis and other biochemical methods such as DNA probes are expected to add much to our biosystematic knowledge of Phlebotominae but will not replace existing diagnostic aids in the near future.

In the meantime we hope that this review, and possible later revisions of it, will serve as a guide to the biosystematics of at least one important genus in the subfamily.

Financial support for this project was provided mainly by the U.S. Army Medical Research and Development Command (Contract No. DAMD17-82-C-2223). We are indebted to this organization and to many individuals who provided needed help in all phases of this study. They will be acknowledged when this review is published elsewhere following some modifications of format, not content. Barbara Hollien, Department of Entomology & Nematology, University of Florida, deserves credit at this time for cheerfully typing the manuscript quickly and with few errors.

# PART II

# CLASSIFICATION

## 1. General

The family Psychodidae of Diptera is divided into four or more subfamilies according to author (see Lewis et al. 1977). The two subfamilies containing hematophagous females are Sycoracinae and Phlebotominae, the latter group distinguished from the former, and other subfamilies, by the following adult character states (Pl. 2-1).

-- Radius of wing with 5 branches

-- Mouthparts relatively long, adapted for bloodsucking

-- Maxillary palpus of 5 palpomeres

-- Paired spermathecae

Lewis et al. (1977) also discussed the various classification schemes that have been proposed for Phlebotominae at the subfamily and lower levels. We adopt the classification, as outlined by them, by recognizing three genera in the New World -- Lutzomyia, Brumptomyia França & Parrot and Warileya Hertig. There are also three genera in the Old World -- Phlebotomus Rondani & Berté, Sergentomyia França & Parrot and Chinius Leng. The latter genus was recently created to accommodate an unusual sand fly from China (Leng 1987. Ann. Trop. Med. Parasit. 81: 311-317).

2. American Phlebotominae

The genus Brumptomyia includes 22 species distributed from southern Mexico to northern Argentina (Martins et al. 1978). Adults are commonly found in armadillo burrows, sometimes on tree trunks or in light and flight traps. None of the species has been reported biting man. Identification of species is based almost entirely on male structures (see Fraiha et al. 1970a for key to species & refs.).

The smaller genus Warileya is represented by 6 species known from Costa Rica (Murillo & Zeledón 1985), Panama (Fairchild & Hertig 1951b), Colombia (Young 1979), French Guiana (Le Pont & Desjeux 1984a), Bolivia (Velasco & Trapido 1974) and Peru (Hertig 1948; Vargas & Pérez 1985). Females of W. phlebotomanica Hertig and W. rotundipennis Fairchild & Hertig are anthropophilic and it is likely that some others share the same habit. None of the Warileya species has been implicated in disease transmission but little is known about their relationships with human pathogens. Warileya hertigia (Fairchild) was originally described in the genus Hertigia Fairchild (Lewis et al. 1977).

The genus Lutzomyia contains the majority of American Phlebotominae with nearly 400 species and subspecies reviewed in the present paper and separated from the Warileya and Brumptomyia species by the following key to the adults.

3. Key to the Genera of New World Phlebotominae

1. Wing broad, rounded at tip; $R_2 + R_3 + R_4$ forks before, above or but slightly beyond r-m crossvein. Male terminalia with style longer than coxite. Thorax without episternal setae ..... ..... Warileya (Pl. 2-1)

   Wing relatively narrow, pointed at tip; $R_2 + R_3 + R_4$ forks well beyond r-m crossvein. Male terminalia with style usually shorter than coxite. Thorax with episternal setae ..... 2

2. Male terminalia with style bearing 5 spines, 2 of which are borne on a common tubercle (usually proximal pair). Coxite with 1 or more long distal setae in addition to persistent setae at base or middle. Female cibarium with 4 longitudinal rows of horizontal teeth. Head with complete interocular suture ..... ..... Brumptomyia (Pl. 2-1)

   Male terminalia with style bearing 1-8 spines; if 2 spines are borne on a common tubercle of those species having 5 spines, then there are no distal setae on the coxite. Female cibarium with 1 transverse row of horizontal teeth or lacking them altogether. Head with interocular suture usually incomplete ..... ..... Lutzomyia (Pl. 11-1 & 11-2)

For the most part, we follow the subgeneric classification of Lutzomyia given by Lewis et al. (1977). Exceptions are noted in the text. This scheme

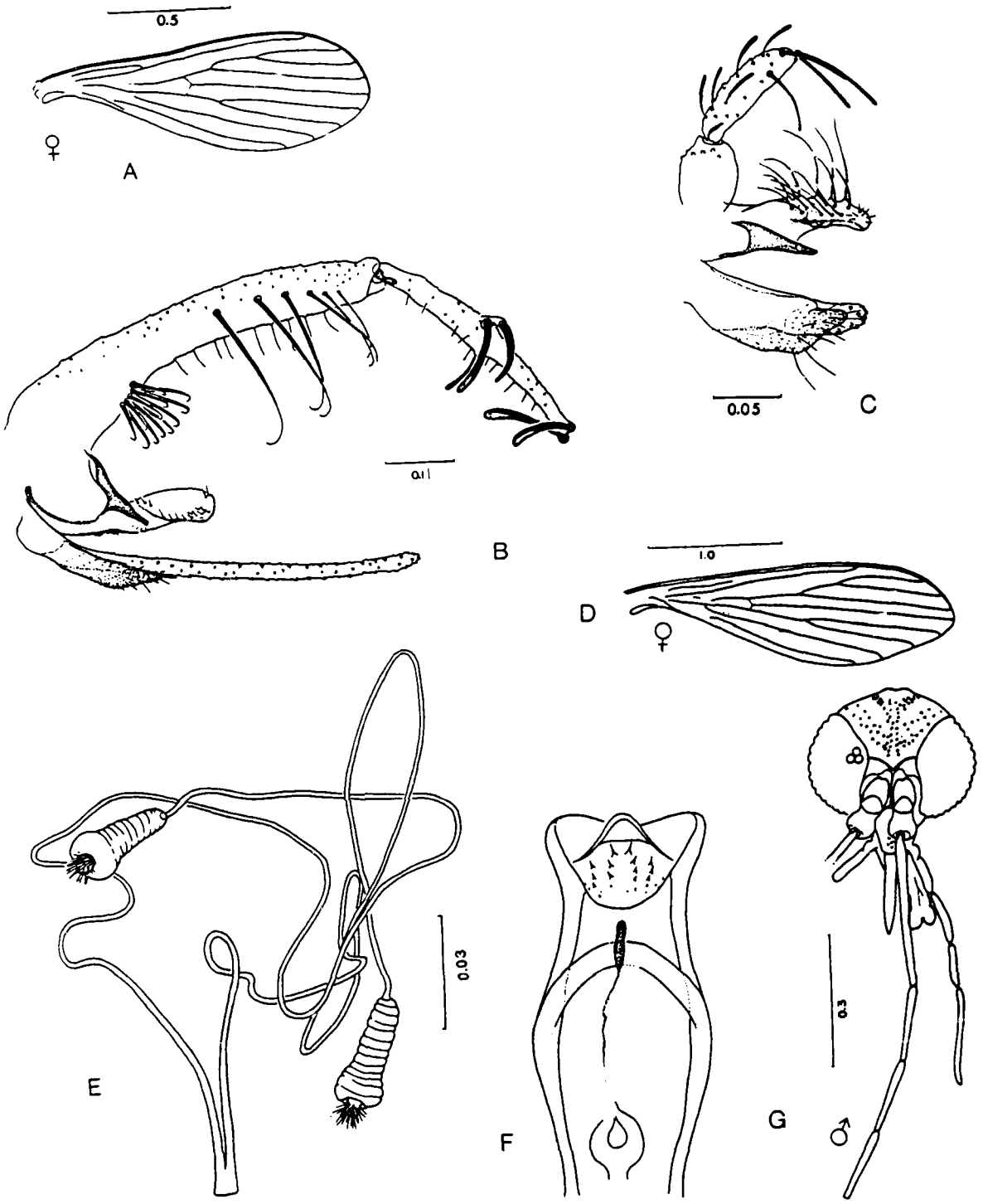



Plate 2-1

Warileya sp. A. Female wing; C. Male terminalia.

Brumptomyia sp. B. Male terminalia; D. Female wing; E. Spermathecae; F. Female cibarium; G. Male head.

includes species groups that are equivalent in rank to subgenera. The terms, "series" and "complex," refer to groups of species within subgenera or species groups.

Creating an unambiguous key to the subgenera and species groups of Lutzomyia is beset with problems. Subgeneric characteristics may be obvious in one sex, but not the other, so that in many cases both sexes must be on hand before the specimens can be assigned to a particular group. For example, some males in the verrucarum, migonei and other groups that are keyed to couplet 25 can not be separated from one another at this level. Accordingly, it may be necessary to use two or more appropriate species keys to identify a particular specimen. Relative terms such as short, long, etc. can be understood by comparing figures of the structures under consideration.

4. Key to the Subgenera, Species Groups and Ungrouped Species of Lutzomyia

1. Hind femur with row of short spines .....
..... Subgenus Pintomyia (p. 325)
Hind femur without spines ..... 2

2(1). Palpomere 5 shorter than 1/2 length of palp. 3. Spermathecae imbricated. Coxite without persistent setae .....
..... Subgenus Psychodopygus (p. 676)
Palpomere 5 longer than 1/2 length of palp. 3. Spermathecae otherwise. Coxite with or without persistent setae ..... 3

3(2). Male ..... 4

Female ..... 36

4(3). Lateral lobe markedly inflated ..... Subgenus Coromyia (p. 274)
Species Group Delpozoi, in part (p. 293)

Lateral lobe not inflated ..... 5

5(4). Lateral lobe with 2 or more dorsal spatulate setae at or near apex ..... Subgenus Evandromyia, in part (p. 370)

Lateral lobe without such spatulate setae ..... 6

6(5). Coxite with distal row or group of 3-8 long setae ..... 7

Coxite without distal row or group of long setae but a group of 10+ short setae sometimes present ..... 9

7(6). Style with subterminal seta. Palpomere 5 longer than combined length of palps. 2 + 3 ..... Species Group Baityi (p. 360)

Style without subterminal seta. Palpomere 5 shorter than combined length of palps. 2 + 3 ..... 8

8(7). Antennal ascoids bifurcate, i.e., each with long proximal spur ..... Species Group Dreisbachi (p. 499)

Antennal ascoids simple or nearly so .....
..... Subgenus Trichophoromyia, in part (p. 603)

9(6). Genital filament tips extremely inflated, maximum width of each greater than width of genital pump .....
..... Lutzomyia (ungrouped) n.sp. #1 (p. 936)

Genital filament tips simple or inflated but never as wide as above ..... 10

10(9). Style simple, with 2-3 spines ..... 11

Style simple or forked, with 4-8 spines ..... 15

11(10). Coxite with basal group of persistent setae ..... 12

Coxite without basal group of persistent setae ..... 13

12(11). Coxite tuft of modified setae, in part. Style with small median and subterminal seta in addition to 3 strong spines ..... Subgenus Pressatia (p. 343)

Coxite turf of simple setae. Style without small median seta; subterminal seta & 3 strong spines present ..... ..... Species Group Verrucarum, in part (p. 234)

13(11). Paramere trifurcate ..... L. boliviana, ungrouped (p. 935)

Paramere simple or with dorsal arm ..... 14

14(13). Paramere with dorsal arm ..... ..... Subgenus Dampfomyia, in part (p. 301)

Paramere without dorsal arm ..... Species Group Pilosa (p. 818)

15(10). Style with 4 spines ..... 16

Style with 5-8 spines ..... 30

16(15). Style forked, without subterminal seta ..... 17

Style usually unforked, but if appearing forked, subterminal seta present ..... 18

17(16). Coxite with 7 or more persistent setae at inner base. Paramere without modified dorsal setae. Palpomere 5 longer than 1.5X length of palp. 3 .....
..... Species Group Rupicola (p. 408)

Coxite without persistent setae at base. Paramere with 2-4 modified dorsal setae. Palpomere 5 shorter than 1.5X length of palp. 3 ..... Subgenus Viannamyia (p. 396)

18(16). Coxite with ventral row of numerous long setae, no basal tuft. *Paramere bifurcate, trifurcate or with dorsal arm* ..... Subgenus Trichopygomyia (p. 508)

Coxite without ventral row of long setae in those males also lacking a basal tuft. Paramere divided or not, with or without dorsal arm ..... 19

19(18). Paramere trifurcate. Aedeagus with short or long lateral extensions ..... Subgenus Evandromyia, in part (p. 370)

Paramere simple or bifurcate. Aedeagus without lateral extensions ..... 20

20(19). Antennal ascoids with conspicuous proximal spurs ..... 21

Antennal ascoids without proximal spurs ..... 22

21(20). Paramere with dorsal basal hump .....

..... Species Group Aragaoi (p. 457)

Paramere without dorsal basal hump .....

..... Subgenus Psathyromyia (p. 413)

Species Group Lanei (p. 491)

L. ignacioi, ungrouped (p. 931)

22(20). Coxite with 1 or more persistent setae at inner base or middle of structure ..... 23

Coxite without persistent setae ..... 25

23(22). Flagellomere I very long, at least 2X length of labrum .....

..... Subgenus Sciopemyia, in part (p. 136)

L. acanthopharynx, ungrouped (p. 934)

Flagellomere I shorter than 2X length of labrum ..... 24

24(23). Paramere with 1-3 isolated setae on dorsal margin near middle of structure ..... Subgenus Lutzomyia, in part (p. 58)

Species Group Migonei, in part (p. 154)

Species Group Verrucarum, in part (p. 211)

Species Group Delpozoi, in part (p. 293)

Paramere without such isolated seta or setae .....

..... Species Group Migonei, in part (p. 154)

Species Group Verrucarum, in part (p. 211)

Species Group Saulensis (p. 318)

Species Group Delpozoi, in part (p. 293)

L. paulwilliamsi, ungrouped (p. 927)

25(22). Style with isolated proximal spine .....

..... Subgenus Trichophoromyia, in part (p. 603)

Subgenus Nyssomyia, in part (p. 539)

Subgenus Micropygomyia, in part (p. 770)

L. rangeliana, ungrouped (p. 930)

L. species of Anchicaya, ungrouped (p. 933)

L. samueli, ungrouped (p. 934)

Style with paired or nearly paired proximal spines ..... 26

26(25). Coxite with basal or median group of setae implanted on raspberry-shaped tubercle ...Subgenus Lutzomyia, in part (p. 58)

Coxite with persistent setae implanted otherwise ..... 27

27(26). Style with subterminal seta .....

..... Species Group Verrucarum (L. nevesi) (p. 235)

Style without subterminal seta ..... 28

28(27). Flagellomere I longer than 2X length of labrum .....

..... Subgenus Sciopemyia, in part (p. 136)

Flagellomere I shorter than 2X length of labrum ..... 29

29(28). Palpomere 5 longer than combined length of palps. 3 + 4 ....

..... Subgenus Micropygomyia, in part (p. 770)

Palpomere 5 shorter than combined length of palps. 3 + 4 ...

..... Subgenus Nyssomyia, in part (p. 539)

L. brisolai, ungrouped (p. 933)

L. monticola, ungrouped (p. 926)

L. misionensis, ungrouped (p. 928)

30(15). Paramere divided or with dorsal arm ..... 31

Paramere simple, without dorsal arm ..... 32

31(30). Style with subterminal seta. Paramere width greater than that of coxite; dorsal arm with apically recurved setae .... ..... Subgenus Dampfomyia (L. insolita) (p. 307)

Style without subterminal setae. Paramere otherwise ..... ..... Species Group Oswaldoi, in part (p. 826)

32(30). Style with subterminal seta ..... 33

Style without subterminal seta ..... 35

33(32). Coxite with basal or median tuft of setae ..... 34

Coxite without persistent setae ..... L. pia, ungrouped (p. 929)

34(33). Paramere somewhat clubbed. Coxite tuft of foliaceous setae ..... Species Group Migonei (L. bahiensis) (p. 170)

Paramere not clubbed. Coxite tuft of simple setae ..... ..... L. torrealbai, ungrouped (p. 932)

35(32). Style with median spines inserted on a common process ..... ..... L. oligodonta, ungrouped (p. 935)

Style with no 2 spines on a common process ..... 36

36(35). Paramere with 2-6 hooked or otherwise modified setae on dorsal margin ..... Subgenus Lutzomyia, in part (p. 58)

Paramere with simple setae .....

..... Species Group Oswaldoi, in part (p. 826)

Species Group Vexator (p. 890)

Subgenus Micropygomyia, in part (p. 770)

37(36). Spermathecae associated with paired sclerotized structures as shown ..... Subgenus Viannamyia (p. 396)

Spermathecae without such structures ..... 38

38(37). Spermathecae with bubble-like evaginations .....

..... Subgenus Dampfomyia (p. 301)

Species Group Saulensis (p. 318)

Species Group Verrucarum, in part (p. 211)

Spermathecae without bubble-like evaginations ..... 39

39(38). Antennal ascoids with distinct proximal spurs ..... 40

Antennal ascoids simple or with barely discernible short proximal spurs ..... 41

40(39). Cibarium with 4 horizontal teeth .....

..... Subgenus Psathyromyia, in part (p. 413)

Species Group Lanei (p. 491)

Species Group Aragaoi, in part (p. 457)

L. ignacioi, ungrouped (p. 931)

Cibarium with 6 or more horizontal teeth .....

..... Subgenus Psathyromyia, in part (p. 413)

Species Group Aragaoi, in part (p. 457)

Species Group Dreisbachi (p. 499)

L. ponsi, ungrouped (p. 932)

41(39). Pharynx with numerous posterior spines ..... 42

Pharynx without posterior spines ..... 43

42(41). Cibarium with 6 or more horizontal teeth .....

..... Subgenus Micropygomyia, in part (p. 770)

Cibarium with 4 horizontal teeth .....

..... Subgenus Micropygomyia, in part (p. 770)

Species Group Oswaldoi, in part (p. 826)

L. acanthopharynx, ungrouped (p. 934)

43(41). Cibarium with 0-2 horizontal teeth ..... 44

Cibarium with 4 or more horizontal teeth ..... 46

44(43). Cibarium without horizontal teeth. Individual sperm ducts very long, ca. 8X length of spermatheca .....

..... L. oligodonta, ungrouped (p. 935)

Cibarium with 2 horizontal teeth. Individual sperm ducts much shorter than 8X length of spermatheca ..... 45

45(44). Cibarium with subtriangular, pointed horizontal teeth. Spermatheca with distinct annulations, its length greater than that of individual sperm duct ..... ..... Species Group Migonei

Subgenus Lutzomyia, in part (p. 154)

Cibarium with blade-like horizontal teeth. Spermatheca sac-like & striated, without distinct annulations, its length much shorter than that of individual sperm duct ..... ..... Species Group Delpozoi (p. 293)

46(43). Individual sperm ducts heavily sclerotized as shown ..... ..... Subgenus Pressatia (p. 343)

Individual sperm ducts not heavily sclerotized ..... 47

47(46). Cibarium with 4 horizontal teeth ..... 48

Cibarium with 6 or more horizontal teeth ..... 62

48(47). Spermathecae with large bladder-like expansion ..... ..... Subgenus Coromyia, in part (p. 274)

Spermathecae otherwise, without bladder-like expansion ..... 49

49(48). Spermathecae sac-like & enormous, without terminal knob .... ..... L. bursiformis, ungrouped (p. 929)

Spermathecae otherwise, terminal knob usually present (exception: L. firmatoi) ..... 50

50(49). Cibarium with comb-like row of horizontal teeth .....
..... Species Group Pilosa (p. 818)
Cibarium with horizontal teeth otherwise ..... 51

51(50). Individual sperm ducts greatly inflated .....
..... Species Group Migonei (p. 154)
Individual sperm ducts not inflated as above ..... 52

52(51). Cibarium with wide gap between middle pair of horizontal teeth ..... 53
Cibarium with horizontal teeth more or less evenly spaced .. 54

53(52). Palpomere 5 subequal to, or shorter than, palps. 3 + 4. Spermathecae slender, subequal in width & annulated throughout ..... Subgenus Sciopemyia (p. 136)
Spermathecae smooth-walled or annulated, but if annulated then terminal annulation much larger than others .....
..... Species Group Oswaldoi, in part (p. 826)

54(52). Spermatheca with basal annulation nearly twice as wide as terminal annulation, each connected by slender stalk .....
..... L. boliviana, ungrouped (p. 935)
Spermathecae otherwise ..... 55

55(54). Spermathecae smooth-walled or else with only incipient, incomplete striations only at base ..... 56

Spermathecae with distinct, complete annulations or striations, in whole or part ..... 58

56(55). Spermathecae curved apically like an inverted "j"; individual sperm duct with median or distal transverse constriction ..... Subgenus Evandromyia, in part (p. 370)

Spermathecae & individual ducts otherwise ..... 57

57(56). Common sperm duct longer than individual ducts .....

..... Species Group Rupicola (p. 408)

Species Group Migonei, in part (p. 154)

Common sperm duct subequal to, or shorter than, individual duct ..... Species Group Baityi (p. 360)

Subgenus Helcocyrtomyia, in part (p. 871)

Species Group Migonei, in part (p. 154)

58(55). Palpomere 5 subequal to, or shorter than, combined length of palps. 3 + 4 ..... 59

Palpomere 5 longer than palps. 3 + 4 ..... 60

59(58). Spermathecae as shown; common sperm duct clearly much longer than individual duct ..... L. pia, ungrouped (p. 929)

Spermathecae otherwise; common sperm duct shorter than individual duct ..... Subgenus Helcocyrtomyia, in part (p. 871)

L. brisolai, ungrouped (p. 933)

60(59). Spermathecae sac-like, striated ..... 61

Spermathecae otherwise .....

..... Subgenus Helcocyrtomyia, in part (p. 371)

Subgenus Lutzomyia, in part (p. 58)

Subgenus Micropygomyia, in part (p. 770)

Species Group Oswaldoi, in part (p. 826)

61(60). Individual sperm ducts clearly shorter than common duct ...

..... Subgenus Evandromyia, in part (p. 370)

Species Group Verrucarum, in part (p. 211)

Species Group Migonei (L. gruta) (p. 165)

L. rangeliana, ungrouped (p. 930)

Individual sperm ducts subequal to, or longer than, common duct ..... Species Group Verrucarum, in part (p. 211)

Subgenus Trichopygomyia (p. 508)

L. monticola, ungrouped (p. 926)

L. misionensis, ungrouped (p. 928)

62(47). Cibarium with comb-like row of horizontal teeth .....

..... Subgenus Micropygomyia, in part (p. 770)

Cibarium with horizontal teeth otherwise ..... 63

63(62). Palpomere 5 shorter than combined length of palps. 3 + 4 ... 64

Palpomere 5 longer than combined length of palps. 3 + 4 .... 65

64(63). Antennal ascoids with barely discernible posterior spurs. Cerci characteristically short & broad .....

..... Subgenus Trichophoromyia (p. 603)

Antennal ascoids simple. Cerci otherwise .....

..... Subgenus Nyssomyia (p. 539)

L. pia, ungrouped (p. 929)

65(64). Spermathecae sac-like, about as wide as long .....

..... Lutzomyia (ungrouped) n.sp. #1 (p. 936)

Spermathecae otherwise, longer than wide .....

..... Subgenus Lutzomyia, in part (p. 58)

PART III

BIOLOGY OF LUTZOMYIA

Information and references on the biology of individual sand fly species are given in the species account. This section serves only to provide some general facts on the subject.

## 5. Immature Stages

The eggs of about 40 New World species have been described (Endris et al. 1987b). They are dark and elliptical (Pl. 5-1) and are presumably laid in small batches in moist habitats such as rock crevices, bases of trees, leaves on the forest floor, animal burrows, and similar microhabitats. The egg surface has ridges or other protuberances that form patterns typical of the species or species complex.

The usual number of eggs laid by a female sand fly during a single oviposition cycle ranges from 40-70+ depending on species, size, and nature of the previous blood meal, larval diet, and other factors. A few species of Lutzomyia are autogenous, i.e., females will oviposit their first batch of eggs without having had a previous blood meal (Johnson 1961). Subsequent ovipositions, however, are possible only after the female fly has taken a blood meal.

Hatching usually occurs within 10 days after oviposition, but for reasons not well understood, some eggs in a batch may have a prolonged incubation period, hatching 30, 40, or more days after the others when kept

under identical conditions (staggered or delayed egg hatch). There is also some evidence that some species survive adverse conditions (cold weather or dry periods) in the egg stage (Young & Lawyer 1987).

At present, the larvae of about 62 species of Lutzomyia and Brumptomyia have been described. The larvae (Pl. 5-1) are small and caterpillar-like with a well developed head capsule, many brush-like setae on the body and long caudal setae, the length of which may be related to the habits of the species. Surface feeders generally have longer caudal setae than those that burrow (Hanson 1968). Mature larvae (4th instar) of the Brumptomyia spp. have only 2 caudal setae; whereas those of Lutzomyia have 4.

Upon hatching, the first instar larvae begin to feed on available dead organic matter, sometimes including the egg shell from which they may ingest oocysts of gregarine parasites (protozoa). Larvae have been recovered from soil in animal burrows, on dead leaves on the forest floor at the base of large trees, in debris from depressions in trees, and in other moist microhabitats.

Developmental time for sand fly larvae of some species can be a short as 18 days but may be prolonged for months during cold or dry weather conditions.

Before transforming to a pupa (Pl. 5-1), the mature larva ceases to feed and seeks a place, usually drier than where it previously lived, to pupate. The pupa is attached to an object such as a dead leaf, stone, or other object and compressed larval skin can be seen at the posterior end (the end attached

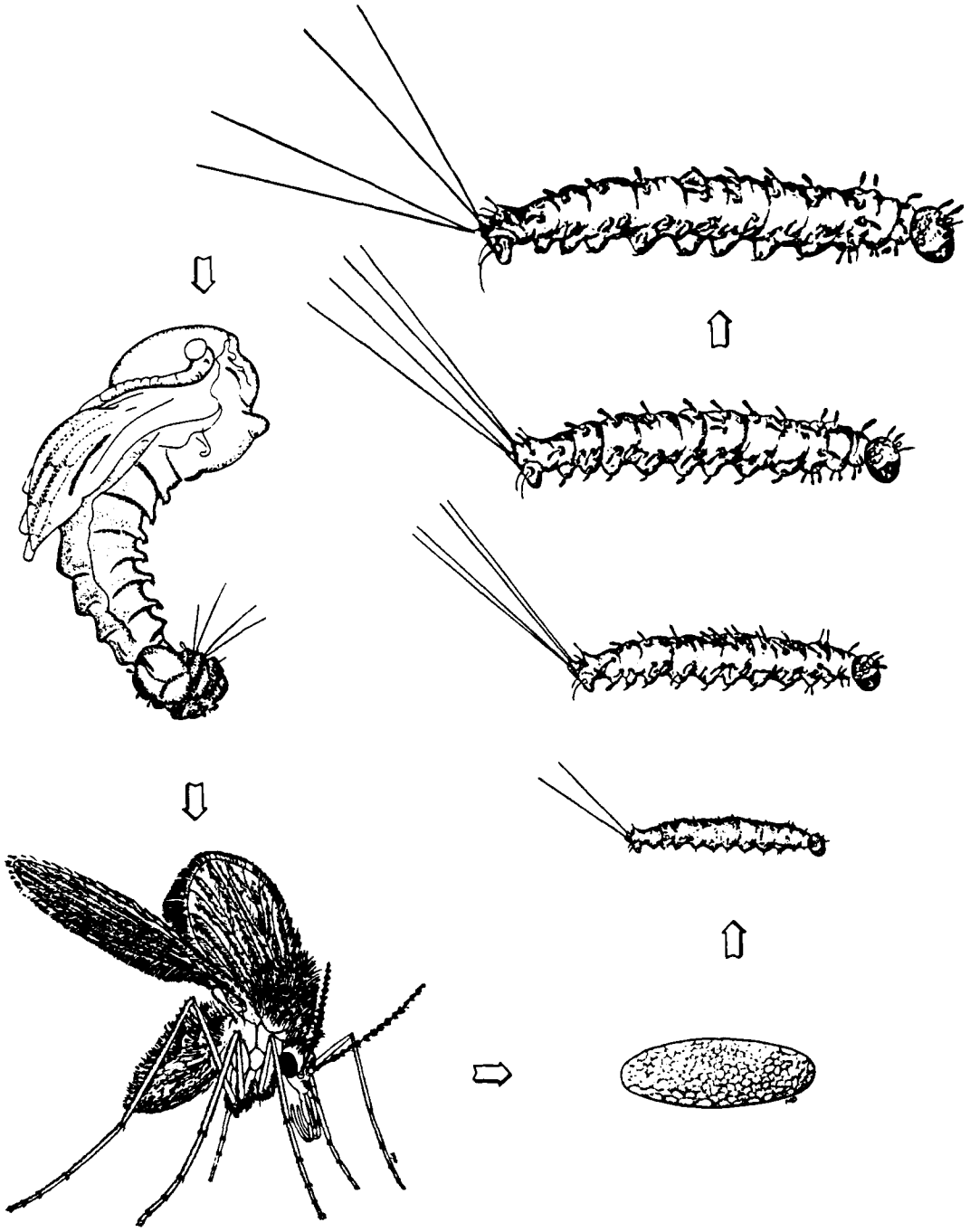


Plate 5-1

Life cycle of Lutzomyia showing egg, larval instars, pupa and adult female.

to the substrate) of the pupa (Pl. 5-1). This resting stage ordinarily lasts from 7-12 days, the males usually emerging before the females.

6. Adults

Within 24 hours following emergence, males rotate their external genitalia 180° and become sexually mature. Locating a receptive female may be aided by pheromones (both ♂ and ♀?) and by locating a resting site or vertebrate host where females are present. Males of L. longipalpis usually outnumber females on vertebrate hosts and mating may occur when the females are taking a blood meal. Premating courtship behavior, including rapid wing beating of males, has been witnessed when both sexes are close together (within several centimeters). Mating swarms have not been observed in Phlebotominae.

Spermatozoa are held in the female spermathecae and can be seen with the aid of light microscopy in dissected flies. One mating may not be sufficient to inseminate a female for her lifetime.

Feeding Habits

Adults of both sexes require carbohydrates (sugars) for energy, the source of which continues to baffle investigators. The fact that sand flies ingest sugar has been established by means of the cold anthrone test and chromatography. It has been reported or suggested that flies will feed on honeydew from aphids or other Homoptera, nectar from flowers, fruits, and other plant juices. Carbohydrates may also affect the development and

infectivity of Leishmania in sand flies so it is important to know the origin of these sugars to help understand the dynamics of disease transmission.

Anautogenous females require vertebrate blood for the maturation of their eggs; some species feed once between ovipositions, whereas others (e.g., L. shannoni) may take multiple blood meals during a single oviposition cycle.

Members of the subgenus Coromyia of Lutzomyia feed almost exclusively on bats or rodents; Brumptomyia females presumably feed mostly on armadillos; some species feed primarily on reptiles or amphibians whereas others are opportunistic, feeding on a variety of mammals and/or birds depending on their availability. The precipitin test for blood meal identification has proved useful for studying the natural hosts of Lutzomyia species in Panama and Brazil (e.g., Tesh et al. 1971a).

Most man-biters feed at dusk and during the evening but L. wellcomei, L. carrerai, and others will attach in the daytime as well. Windless or nearly windless conditions, along with other optimal conditions, may suddenly induce greater-than-expected numbers of sand flies to seek their hosts. Blood-feeding females may release aggregation pheromones that attract other females to the host as well.

The majority of anthropophilic sand flies in the Americas are exophilic, biting persons outside of their houses. Lutzomyia trapidoi is an example of such a species. Others, including L. gomezi, L. verrucarum, L. longipalpis, and some of the Lutzomyia (Nyssomyia) spp., readily enter human dwellings

where they bite the occupants. Porch or other lights inside houses may also help attract some anthropophilic species to homes. The degree of anthropophily varies not only among species but also among populations of conspecific populations. Lutzomyia shannoni, for example, is commonly attracted to human baits in southern Mexico but is rearly observed biting man further south in Central or South America.

## Flight Range

We know little about the dispersal and flight range of American Phlebotominae. Chaniotis et al. (1974) in Panama marked 20,000 wild-caught flies with fluorescent powders, released them at ground level and in the canopy, then recaptured fewer than 9% of marked individuals as long as 13 days afterwards. Four sand flies flew 200 m from the release point but the majority were recaptured within a radius of 57 m, indicating that there is a limited flight range of these forest-inhabiting species. There is also vertical movement, perhaps daily, of some Lutzomyia species from the forest floor to canopy.

## Resting Sites

The type of resting site used by adult sand flies varies according to availability of microhabitat, season, amount of moisture present and species of sand fly. Lutzomyia longipalpis, a species usually occurring in nonforested areas, is often found resting in rock crevices or caves, if they are present. In localities lacking these shelters, such as in NW Costa Rica, the resting sites of this species have not yet been determined.

The tropical rain forest offers the greatest variety of resting sites and it is there that most sand fly species occur. Resting sites that become excessively wet are abandoned by these insects but may be utilized at other times when conditions become more favorable.

The forest floor itself is the most extensive microhabitat used by resting sand flies [e.g., L. flaviscutellata, L. olmeca, and some Lutzomyia (Psychodopygus) spp.]. These and other species are also found on the undersides of leaves of small shrubs and plants, particularly when the forest floor becomes too wet. Lutzomyia umbratilis, L. ylephiletor, and L. shannoni are associated with tree trunk resting sites; L. anthophora and some other Lutzomyia (Dampfomyia) spp. rest in mammal nests which may also serve as breeding sites; the Brumptomyia spp. and those in the Lutzomyia aragaoi group was often found in armadillo burrows; some Lutzomyia (Coromyia) species are commonly found resting in hollow trees or caves that are occupied by bats. Anthropophilic species of Lutzomyia that enter homes to feed may rest on the inside walls for a short time, usually leaving within 24 hours after the blood meal.

## Seasonal Distribution

The abundance of sand flies may or may not vary greatly throughout the year depending on locality. When there are seasonal fluctuations in temperature (temperate zones) or in precipitation (neotropics), seasonal changes in sand fly populations are usually marked. Populations of L. umbratilis in French Guiana are highest at the beginning and end of the rainy season (based on man-biting collections). Populations of L. longipalpis in

Ceará, Brazil, increase during the rainy season (January to May) and reach a peak shortly after the rains stop.

It is not always possible to predict when populations of a particular species will be highest based on results of studies done elsewhere. For example, in one study in Panama the man-biting activity of L. panamensis was greatest during the dry season but dissimilar results were obtained in northern Colombia where biting activity of this species was greatest during the rainy season (Porter & De Foliart 1981).

## Parasites

Young & Lewis (1977) summarized published reports of parasites (excluding mites) that have been observed in phlebotomines. Adult sand flies have been found naturally infected with various protozoans, nematodes, cestodes, fungi, bacteria, and virses. Mites sometimes attach to the exoskeleton of adult flies (Lewis & Macfarlane 1981). The effects of these organisms on the longivity, reproductive capacity and development of sand flies are essentially unknown.

PART IV

MEDICAL IMPORTANCE OF LUTZOMYIA

7. Arboviruses

In general, viruses transmitted to man by sand flies cause influenza-like symptoms including fever, retro-orbital pain, myalgia and malaise. The duration of illness lasts from two to five days and there are no reports of deaths due to phlebotomine-borne viruses. The best known arboviruses associated with phlebotomines belong in the genus Phlebovirus, family Bunyaviridae. Tesh (1988) reviewed this genus, listing 25 serotypes from the New World. Sixteen of these were isolated from pools of Lutzomyia sand flies. Five additional, but as yet unnamed, phleboviruses have been isolated from pools of Colombian and Guatemalan sand flies (R. Tesh, pers. comm.).

There is ample evidence indicating that many, if not all, phleboviruses are transovarially transmitted by their insect hosts (Endris et al. 1983; Tesh 1988). It is also believed that horizontal transmission from vertebrate host to the sand fly vector is also important in maintaining these viruses under natural conditions.

The Changuinola serogroup (Reoviridae: Orbivirus) represents a large number of viruses, apparently closely related, and isolated from Lutzomyia, sloths, other vertebrates and one mosquito species (in the New World only) (Tesh & Chaniotis 1975; Travassos et al. 1984. Intervirology 21: 38-49). Tesh et al. (1974) found Changuinola virus in many pools of sand flies in

Panama, the only country in which human illness due to Changuinola virus has been reported.

Lutzomyia sand flies have also been found naturally infected with vesiculoviruses (Rhabdovridae: Vesiculovirus) in Panama, Colombia and Brazil (see Tesh et al. 1987 for refs.). There is evidence indicating that these viruses are also transovarially transmitted. Natural and experimental infections in male sand flies have been documented. Some of vesiculoviruses, such as VSV-Indiana serotype, infect a variety of animals, including man (Tesh & Chaniotis 1975).

8. Bartonellosis or Carrion's Disease

Schultz (1968) gives an informative account on the history of this disease which remains endemic in Peru (Vargas & Pérez 1985) and Ecuador (Huerta et al. 1978. Rev. Ecuat. Hyg. Med. Trop. 31: 37-47). An earlier epidemic in southern Colombia lasted until the mid-1940's, but no additional human cases have been reported from there since that time.

Results of epidemiological studies of bartonellosis, caused by Baronella bacilliformis, in Colombia suggested that L. columbia was the probable vector (Rozeboom 1947b). No information on possible vectors in Ecuador is yet available. Lutzomyia verrucarum is the suspected vector in Perú (Hertig 1942).

There are many unanswered questions regarding the epidemiology of bartonellosis. No reservoir host, other than man, has been identified and

the developmental cycle of Bartonella in its natural vector has been little studied (Hertig 1942).

## 9. The Leishmaniases

The leishmaniases, a group of diseases caused by trypanosomatid protozoa in the genus Leishmania, are the best known and most important of the sand fly-borne diseases. Autochthonous human cases have been reported from most countries in the Americas except for Chile, Uruguay and some islands of the Caribbean. Clinical signs of infection are variable. Single or multiple lesions of the skin are commonly observed in patients having cutaneous leishmaniasis. Leishmania (Viannaia) species may later cause mucocutaneous disease in some individuals. This condition and diffuse cutaneous leishmaniasis are difficult to treat with available drugs. Visceral leishmaniasis can be fatal, if not treated. Children are especially susceptible to this disease which is caused by Leishmania chagasi, an organism believed to be identical with Leishmania infantum by some authors (e.g., Momem et al. 1987).

Recent advances in identifying these parasites by isozyme profiles, DNA hybridization, monoclonal antibody techniques and other biochemical methods have made it easier to associate specific Leishmania with human, reservoir and vector infections.

Furthermore, the development and use of these diagnostic tools have led to the confirmed realization that many Leishmania taxa exist. Lainson & Shaw (1987) discuss these parasites in detail while proposing a new classification

for the genus. Subspecies were raised to the genus level and a new subgenus, Viannia, was created to accommodate the Leishmania spp. in the braziliensis complex. This name was later changed to Viannaia, without explanation, by editors of the Memorias do Instituto Oswaldo Cruz (Silveira et al. 1987). The remaining Leishmania spp. in the New World are placed in the subgenus Leishmania or else are regarded as ungrouped due to insufficient information. Lainson (1988) outlines the same classification scheme but gives fewer details regarding individual taxa.

Determining which species of sand fly is a vector of leishmaniasis in a given area requires careful, often long-term study. It must be demonstrated that leishmanial parasites from naturally-infected sand flies are indistinguishable from those isolated from humans. The vector species must, of course, be anthropophilic, but it does not necessarily follow that it must be the most common man-biting species in the area. Knowing where and when transmission takes place, correlated with information on the habits, seasonal and geographic distribution of the suspected vector, provides additional evidence for incriminating vector species. The fact that a particular Lutzomyia species is experimentally capable of transmitting leishmanial parasites by bite does not, by itself, conclusively prove that it is a vector in nature. Vectors remain to be discovered in many leishmaniasis foci in the Americas. Lainson & Shaw (1987), Young & Lawyer (1987) and Ryan et al. (1987c) provide reasonably up-to-date summaries and references to New World vectors. Specific references on this subject are cited also in the present review.

# PART V

# TAXONOMIC CHARACTERS

## 10. Preparing Sand Flies for Identification

Before most sand flies can be identified with certainty, several steps should be taken in their preparation. Field-collected material stored dry between layers of tissue paper in small containers (e.g., pill boxes) is preferable to alcohol-preserved specimens, the muscles of which harden with age and become difficult or impossible to macerate at a later time (6+ months after preservation).

Dry or frozen specimens, on the other hand, can be macerated and studied at any time using the following procedures.

A. Place dry flies in 2-5% detergent-water solution for one hour or until they become thoroughly wet and soft.

B. Put flies in crucible containing 10-20% Na OH in water.

C. Heat the Na OH solution to the boiling point; remove crucible from heat source and allow to cool at room temperature for 30 minutes to 2 hours.

D. Lift flies into a drop of 90-95% liquid phenol on a depression microslide. Lactophenol (1 pt. phenol: 0.75 parts lactic acid) can

be substituted but these acids, especially phenol, should be handled and used with care as noted on the original containers.

E. Identify the specimens with the aid of a compound microscope. Phase contrast microscopy will enhance viewing of nearly all structures, especially the delicate antennal ascoids and sperm ducts. A cover glass can be placed over the specimens, if desired.

F. Store identified flies in 70% Ethyl alcohol or else mount on microslides (1 fly/slide) following the method outlined by Young & Perkins (1984). Coloring flies with acid fuschin or other stains may obscure natural coloration and therefore is not necessary.

Specimens on slides can easily be remounted by soaking them in liquid phenol, not xylene, for a week or more. We do not use water-soluble mounting media (e.g., Hoyer's or Berlese's media) for preserving sand flies; these are considered temporary mounts even when properly sealed. In contrast, Canada balsam-preserved specimens will probably last for centuries.

Measurements, given in millimeters in this review, are sometimes made to distinguish closely related species.

## 11. Adult Structures Used In Taxonomy

Structural terminology generally corresponds to that explained and illustrated for nematocerous Diptera by McAlpine (1981). Exceptions are the terms, coxite and style of the male terminalia, instead of gonocoxite and

gonostylus, respectively. Also, we shorten the cumbersome words, "ejaculatory apodeme, sperm pump and aedeagal filaments" to "genital pump and filaments." These and other structures commonly used in sand fly systematics are shown in Plate 11-1 and are briefly discussed below. Additional information on anatomy is given by Fairchild & Hertig (1947a), Kirk and Lewis (1951), Davis (1967), Abonnenc (1972), Lewis (1973, 1975b, 1982, Forattini (1973) and Young (1979).

## Head (Pl. 11-1)

The shape of head is suboval when viewed anteriorally but varies somewhat according to species. Head height is measured from the occiput to the front edge of the clypeus. Maximum width is the greatest distance between the outer margins of the compound eyes.

Compound eyes. The prominent eyes are bare and consist of numerous ommatidial or corneal facets. The shortest distance between the eyes is determined by direct measurement or by the number of facet diameters equalling that distance.

Antennae. The paired, hairy antennae are composed of a basal scape, pedicel and 14 subcylindrical flagellomeres (= antennal segments). The longest flagellomere is always the first (flag. I). It and others bear sensory structures, the most taxonomically important of which are the slender ascoids. these are thin-walled, apically pointed structures that vary in length and number according to species. Ascoids may be simple (without distinct proximal spurs) or they may have proximal spurs of variable length.

Other sensory structures of the antennae, such as papillae (Theodor 1965), are present but their importance in classification remains unknown.

Maxillary palpi. The paired palpi consist of 5 palpomeres. The first (palp. 1) is always the shortest and is partially fused with palp. 2. Palpal sensilla (= Newstead's scales or clavate sensilla) are present on one or more of the palpomeres. The lengths of the palpomeres are sometimes expressed by a formula indicating their relative lengths. For example, 1-2-4-3-5 reflects the fact that palp. 2 is longer than palp. 1, palp. 4 is longer than palp. 2, etc. The length of palpomere 5 differs according to species group or subgenus.

Mouthparts. the appendages arising from the apex of the clypeus, and pointing downwards, collectively form the proboscis. In the female, there are paired, toothed mandibles, paired maxillae and a hypopharynx all of which lie between a ventral labium (which is apically bilobed & setose) and a dorsal labrum that bears 4-8 sensilla at its tip. The length of the labrum from the ventral edge of the clypeus to its tip is often compared to the length of flagellomere I or head height. Lewis (1975a) and Jobling (1976) studied the mouthparts in relation to their function. The mouthparts of male sand flies lack mandibles; other structures are reduced in size.

Cibarium or cibarial pump. The cibarium is an internal structure of the head that lies between the pharynx and the mouthparts. The posterior part of the cibarium, especially that of the female, may have 2 or more

horizontal teeth (= hind teeth) and vertical teeth (= fore teeth). The only Lutzomyia female that lacks such teeth is L. oligodonta from Peru. Lateral teeth, i.e., those on either side of the horizontal teeth, are present in some Lutzomyia spp. The pigment patch represents the site of attachment of the posterior clypeus muscles on the dorsal wall of the cibarium. This patch area varies in size, shape and degree of infuscation according to species. The cibarial or chitinous arch crosses the ventral wall of the cibarium completely in some species or, in others, may be conspicuous only at the sides of the cibarium (incomplete cibarial arch).

Pharynx. The pharynx consists of 3 plates that widen from the junction of cibarium to the posterior end. It is likely that the hind part contains spines in most Lutzomyia females but with light microscopy they are too small to be observed. Some females, however, have a well developed pharyngeal armature.

## Thorax (Pl. 11-2)

The location and intensity of pigmentation of the thorax serve as useful characteristics for distinguishing some Lutzomyia species. The thorax is divided into 3 segments -- the prothorax, the enlarged mesothorax that bears the wings, and the metathorax. Each of these segments is associated with a pair of legs. Episternal, and other, setae are present on the Lutzomyia species but their number and size have relatively low weight in classification at the species level.

Wings. Wing length, measured from the basal costal node to pointed apex, reflects the size of the sand fly and varies between 1 to 3 or more millimeters, depending on species. Certain other measurements of the wing veins are denoted by the following terms. Alpha is the length of $R_2$ from its junction with $R_3$ to the costa. Beta represents the length of R from junction of $R_2$ & $R_3$ to junction with $R_4$. Delta is that part of $R_1$ that extends beyond junction of $R_2$ & $R_3$. Gamma is the length of R from origin of $R_5$ to origin of $R_{2+3}$ & $R_4$. The width of the wing in relation to its length varies by species.

Legs. Distinctive spines occur on the hind femorae of the Lutzomyia (Pintomyia) species and the relative lengths of the segments are sometimes useful as diagnostic features for other species. The leg segments are shown and labelled on Plate 11-1.

## Abdomen (Pl. 11-1 & 11-2)

Coloration of the abdomen varies according to species and the setal pattern of the tergites has been used to group some taxa (Lewis 1975b).

Male structures. The male terminalia or genitalia is described in lateral view following rotation of newly emerged males. The paired coxites and styles are dorsal appendages. The coxite is usually larger than the distal style and may bear persistent (= nondeciduous) setae on its inner surface. The shape and size of these setae differ greatly depending on species. Each style has one or more large spines, their number and arrangement being important in identification. The presence or absence

of a small subterminal seta is generally regarded as a group character but there are exceptions. The paired parameres lie between the coxites and the lateral lobes and may be simple or divided (bifurcate or trifurcate). The setation of the parameres is important as a species-level character. The subtriangular or suboval aedeagi (sing. aedeagus) are conspicuous, often well sclerotized, structures pointing posteriorly or downwards to the lateral lobes. They are fused together at their bases and may have dorsal projections or modified apices. The two genital filaments extend through the aedeagi during mating and sometimes at other times depending on the individual. The filaments join an internal pump within the abdomen and their length, in relation to the pump, is frequently used to separate species. In addition, the tips of the filaments of different species vary in shape. The nonsegmented, paired lateral lobes bear distal persistent setae in a few taxa or they may be greatly inflated in some others. The setose cerci join the lateral lobes at or near their bases but do not vary greatly among most species.

Female terminalia. Externally, the paired and setose cerci are the most conspicuous structures at the end of the abdomen. their size and shape are generally similar in most species but the cerci of the Lutzomyia (Trichopygomyia) spp. are characteristically short & broad.

Internally, there is a well-sclerotized genital fork (= furca) that is shaped like an inverted "Y." Either a common sperm duct or the individual sperm ducts (if the common duct is absent) originate between the lower arms of the genital fork. The actual and relative lengths of

these ducts are important taxonomic features. The paired spermathecae join the individual ducts (or common duct in some species) as illustrated for most of the females shown in this review. The size and shape of the spermathecae show much variation and are salient characters at the species and subgeneric levels.

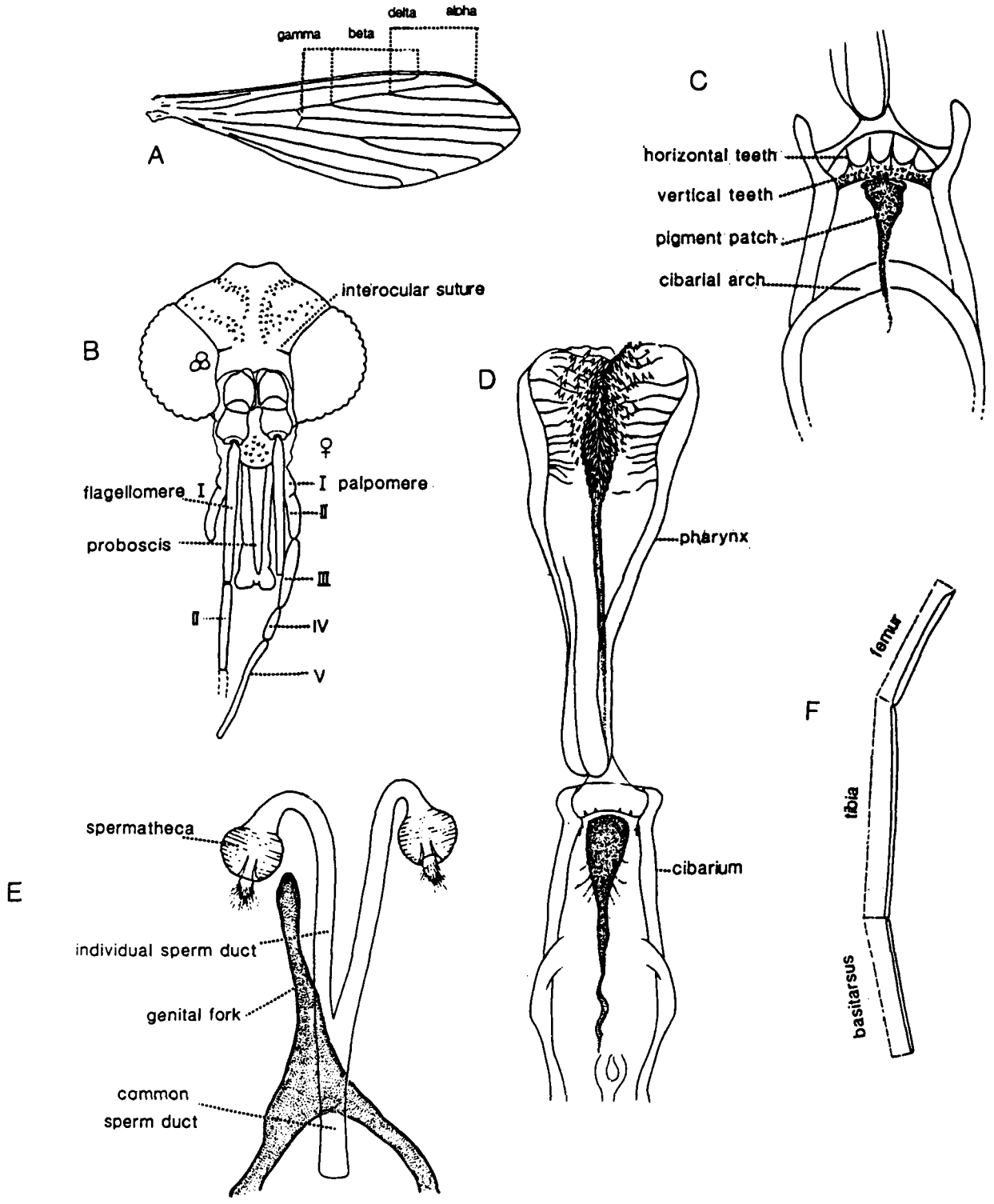



Plate 11-1

Lutzomyia spp., structural terminology. A. Wing; B. Female head; C. Female cibarium; D. Female cibarium & pharynx; E. Spermathecae & genital fork (furca); F. Leg (in part).

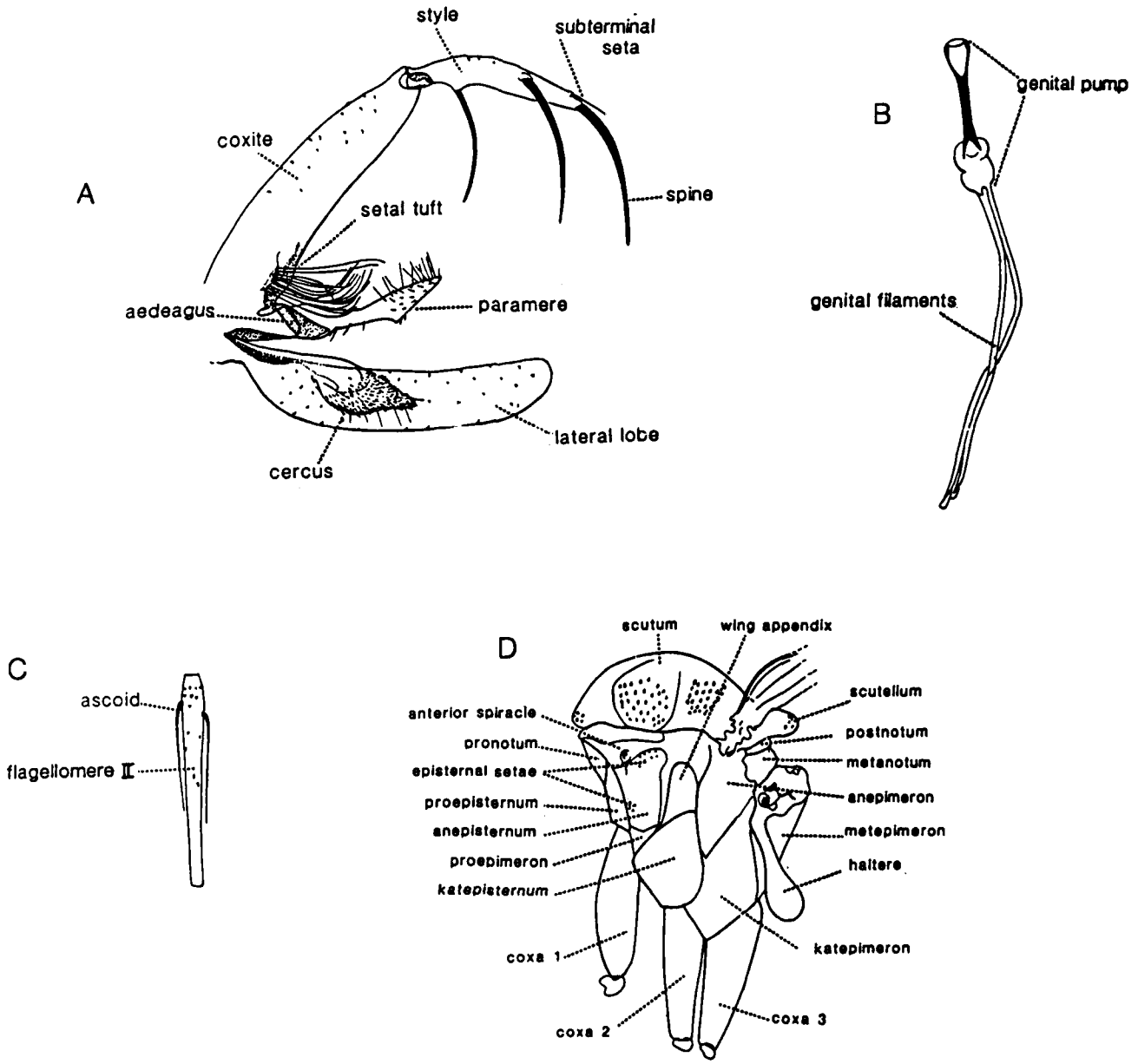



Plate 11-2

Lutzomyia spp., structural terminology. A. Male terminalia, lateral view; B. Genital pump & filaments; C. Flagellomere II showing paired ascoids; D. Thorax.

PART VI

SYSTEMATIC ACCOUNT OF LUTZOMYIA

## 12. Lutzomyia Subgenus Lutzomyia França

Phlebotomus subgenus Lutzomyia França 1924: 10 (type species: Phlebotomus longipalpis Lutz & Neiva). Barretto 1962: 92. Theodor 1965: 181 (in part). Forattini 1971a:99; 1973: 212 (in part). Martins et al. 1978: 18 (in part).

Flebotomus subgenus Castromyia Mangabeira 1942a: 185 (type species: Phlebotomus castroi Barretto & Coutinho 1941, in part). Theodor 1965: 191 (in part).

Lutzomyia species group cruciata Theodor 1965: 181. Martins et al. 1978: 120.

Lutzomyia species group amarali Martins et al. 1978: 148.

Lutzomyia species group gasparviannai Lewis et al. 1977: 325. Martins et al. 1978: 159.

Lutzomyia subgenus Aguayoi (in part): Vargas 1978: 89 (type species: Lutzomyia dispar Martins & Silva by orig. designation).

Identification. Coloration variable, pale to dark. Antennal ascoids simple or with barely discernible proximal spurs. Palpomere 5 usually longer

than palp. 3. ♀ cibarium with 2-12 horizontal teeth & variable number of vertical teeth; arch complete or nearly complete; pigment patch conspicuous. ♀ pharynx unarmed. Spermathecae annulated in part or whole, ducts variable in length. ♂ genitalia. Coxite with simple or modified persistent setae at base. Style with 4-5 spines; subterminal setae present or absent. Paramere with or without isolated seta or setae at median dorsal margin.

In contrast to the classification of Martins et al. (1978), we include more species in this subgenus. The presence of an isolated seta on each paramere of Lutzomyia n.sp. #1 indicates, among other character states, a close affinity to members of the longipalpis complex (= series of authors). The lack of a small subterminal seta on the style of this male suggests its assignment in the cruciata complex which Martins et al. (1978) separate from the subgenus Lutzomyia. More importantly, we believe that female character states of the longipalpis and cruciata complexes are similar enough to justify combining these species in a single subgenus.

We have doubts, however, about placing L. castroi and L. caligata in the subgenus Lutzomyia but will retain them here for the present.

Medical Importance. Considerable; many species are anthropophilic and some are proven and suspected vectors of Leishmania.

## Key to the Males of the Subgenus Lutzomyia

1. Style with 5 spines (cavernicola complex). ..... 2

   Style with 4 spines. ..... 6

2. Coxite with 1-2 highly modified setae, with apices greatly expanded. ..... 3

   Coxite without such setae. ..... ..... 4

3. Paramere undivided, with dorsal group of 5 large apically curved setae. Coxite with blunt spine on a tubercle at inner base, 3 long straight setae & 1 modified seta inserted on another tubercle. ..... L. battistinii (Pl. 12-1)

   Paramere divided into 3 lobes; proximal lobe with 2 apically curved setae. Coxite base with 2 modified setae borne on a tubercle & a long pointed setae isolated above modified setae. ..... L. forattinii (Pl. 12-2)

4. Coxite base with 6 setae implanted on prominent common tubercle. Paramere as shown. ..... L. bicornuta (Pl. 12-3)

   Coxite base with 4 setae inserted individually on small tubercles. Paramere otherwise. ..... 5

5. Paramere deeply indented apically, shaped like a bottle opener. Coxite base with all setae similar in size & shape. ..... L. cavernicola (Pl. 12-4)

Paramere otherwise, not indented. Coxite base with 3 foliaceous & 1 simple setae. ..... L. renei (Pl. 12-5)

6. Coxite base with 2 broad, fan-shaped setae. ..... 7

Coxite base with 4 or more, relatively slender setae. ..... 8

7. Paramere with dorsal process bearing 2 slender recurved setae. Coxite with median group of long, numerous setae. ..... L. bifoliata (Pl. 12-6)

Paramere with dorsal process bearing 2 fan-shaped setae. Coxite lacking a median group of setae. ..... L. lichyi (Pl. 12-7)

8. Paramere with 2-3 distinct isolated setae on dorsum, near base or middle of structure. ..... 9

Paramere with 0 to 1 such setae. ..... 17

9. Paramere with 3 strong, curved setae borne on a slender tubercle. ..... L. dispar (Pl. 12-8)

Paramere with 2 straight or curved isolated setae borne on a tubercle or not. ..... 10

10. Paramere with 2 straight isolated dorsal setae. Style lacking subterminal seta; terminal spines inserted at nearly same level. ..... L. ischnacantha (Pl. 12-9)

Paramere with 2 curved or hooked dorsal setae. Style with small subterminal seta; terminal spines more widely separated. ..... 11

11. Coxite with 6 persistent setae at inner base. Pleura strongly pigmented. ..... L. amarali (Pl. 12-9)

Coxite with 4 persistent setae at inner base. Pleura pale or strongly pigmented. ..... 12

12. Coxite with foliaceous setae at inner base. ..... 13

Coxite with simple setae at inner base. ..... 14

13. Paramere with dorsal curved setae nearly reaching end of paramere. ..... L. cruzi (Pl. 12-10)

Paramere with dorsal curved setae much shorter, reaching only to middle third of paramere. ..... L. souzalopesi (Pl. 12-10)

14. Paramere with dorsal curved setae inserted directly on paramere, i.e., not on a well developed tubercle. ..... L. longipalpis (Pl. 12-11)

Paramere with dorsal curved setae inserted on a well developed tubercle or lobe. ..... 15

15. Style with isolated proximal spine. Paramere as shown. Labrum and flagellomere I subequal in length. ..... L. gaminarai (Pl. 12-12)

Style with paired, or nearly paired, proximal spines. Paramere otherwise. Labrum much shorter than flagellomere I. ..... 16

16. Paramere broader & with 25+ lateral setae on each side. ..... L. ischyracantha (Pl. 12-13)

Paramere more slender & with fewer than 20 lateral setae on each side. ..... L. alencari (Pl. 12-13)

17. Paramere with 1 isolated seta on dorsal margin, near middle of structure. ..... 18

Paramere without such a seta. ..... 20

18. Style with 4 spines & no subterminal seta. Coxite tuft of 12+ persistent setae borne on a raspberry-like tubercle. Paramere with curved isolated seta on dorsum. .....

..... Lutzomyia (Lutzomyia) n.sp. #1 (Pl. 12-14)

Style with 4 spines & small subterminal seta. Coxite tuft of 8 or fewer setae not implanted in a raspberry-like tubercle. Paramere with straight isolated seta on dorsum. ..... 19

19. Paramere with distal 1/2 markedly darker (pigmented) than basal half & covered with scattered setae. Coxite base with 6 setae, some longer than width of coxite. ..... L. caligata (Pl. 12-15)

Paramere without heavily pigmented distal portion; setae, except isolated seta, restricted to distal 1/3 of structure. Coxite base with more slender setae, none longer than width of coxite.

..... L. castroi (Pl. 12-15)

20. Coxite base with a relatively large, elongated tubercle bearing 1 or more foliaceous setae. ..... 21

Coxite base with a raspberry-like, slightly raised circular tubercle bearing only simple setae. ..... 24

21. Genital filaments shorter than 1.7X pump length, tips with small tooth-like serrations. Pleuron pale. ..... 22

Genital filaments longer than 1.7X pump length, tips simple without tooth-like serrations. Pleuron, in part or whole, moderately to strongly pigmented. ..... 23

22. Genital filaments distinctly inflated at tips, heavily sclerotized relatively wide & about 1.3X length of pump ... L. cipoensis (Pl. 12-16)
Genital filaments barely enlarged at tips, lightly sclerotized, more slender & 1.6X length of pump. ..... L. gasparviannai (Pl. 12-17)

23. Coxite tubercle bearing 15 or more setae. .... L. flabellata (Pl. 12-18)
Coxite tubercle bearing 6-9 setae. ..... 24

24. Style with proximal spines inserted at different levels.
..... L. spathotrichia (Pl. 12-19)
Style with proximal spines inserted at same level. ..... 25

25. Coxite tuft of foliaceous & simple setae. Paramere as shown.
..... L. carvalhoi (Pl. 12-20)
Coxite tuft of foliaceous setae only. Paramere otherwise.
..... L. araracuarensis (Pl. 12-21)

26. Pleuron completely pale. ..... 27
Pleuron with well pigmented pronotum at least. ..... 29

27. Scutum lightly pigmented at sides only. Head completely pale.
..... L. evangelistai (Pl. 12-22)

Scutum entirely well pigmented. Head with at least a median longitudinal strip of pigmentation. ..... 28

28. Paramere slightly upturned. Coxite tuft of 40 or more setae borne on a larger tubercle. ..... L. sherlocki (Pl. 12-23)
Paramere not upturned. Coxite tuft of 20 or fewer setae. ..... L. gomezi (Pl. 12-24)

29. Scutum, pronotum & paratergite well pigmented, remainder of pleuron pale. ..... L. cruciata (Pl. 12-25)
Scutum, pronotum, paratergite & anepisternum, at least, well pigmented. ..... 15

30. Paramere upturned, with short dorsal & lateral setae all restricted to distal third of structure. ..... L. marinkellei (Pl. 12-26)
Paramere not upturned, with longer dorsal & lateral setae inserted on distal half or more of structure. ..... L. diabolica (Pl. 12-27)

## Key to the Females of the Subgenus Lutzomyia*

1. Cibarium with 3-4 longitudinal rows of horizontal teeth. Spermathecae as shown. Pleura heavily pigmented, as dark as scutum. ..... L. amarali (Pl. 12-9)

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*The females of L. flabellata, L. castroi, L. araracuarensis and L. caligata are undescribed. The original description of the female of L. gaminarai is inadequate for recognition.

Cibarium with 1 transverse row of 2-10+ horizontal teeth. Spermathecae otherwise. Pleura pale of heavily pigmented. ..... 2

2. Spermathecae longer than individual sperm ducts. ..... 3

Spermathecae much shorter than individual sperm ducts. ..... 4

3. Cibarium with 2 large horizontal teeth. Spermatheca with ca. 8 annulations. ..... L. gasparviannai (Pl. 12-17)

Cibarium with 4 horizontal teeth. Spermatheca with 12-13 annulations. ..... L. cipoensis (Pl. 12-16)

4. Cibarium with 6 or more horizontal teeth. ..... 5

Cibarium with 4 horizontal teeth. ..... 8

5. Cibarium with 6 horizontal teeth. ..... 6

Cibarium with 8-12 horizontal teeth. ..... 7

6. Labrum longer than flagellomere I. Spermatheca with hemispherical terminal annulation much larger than preceding annuli; individual sperm ducts about 4X length of spermathecae... L. diabolica* (Pl. 12-27)

Labrum subequal to, or shorter than, flagellomere I. Spermathecae with terminal annulation about same width as others; individual sperm ducts greater than 8X length of spermathecae. ..... L. alencari (Pl. 12-13)

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*This species is keyed twice; some females have only 4 horizontal teeth in their cibaria.

7. Flagellomere I longer than labrum. Spermathecae about 4X as long as wide, with 12-13 complete annulations. ..... L. souzalopezi (Pl. 12-10)

Flagellomere I subequal to, or shorter than, labrum. Spermathecae shorter, its length less than 4X its width & with fewer annulations. ..... L. longipalpis (Pl. 12-11)

L. cruzi (Pl. 12-10)

L. ischyracantha (Pl. 12-13)

8. Spermathecae with subspherical terminal annulation much larger than any of the preceding annuli. ..... 9

Spermathecae with terminal annulation subequal in size to the 4 preceding annuli, at least. ..... L. battistinii (Pl. 12-1)

L. forattinii (Pl. 12-2)

L. renei (Pl. 12-5)

9. Antennae with terminal flagellomere (XIV) clearly longer than preceding flagellomere (XIII). ..... L. lichyi (Pl. 12-7)

Antennae with terminal flagellomere (XIV) shorter than, or subequal to, preceding flagellomere (XIII). ..... 9

10. Scutum pale. ..... L. bicornuta (Pl. 12-3)

L. cavernicola (Pl. 12-4)

L. ischnacantha (Pl. 12-9)

Scutum pigmented, in part or whole. ..... 11*

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*We have not examined the female of L. dispar. Williams & Carvalho (1979) did not mention its coloration, but the spermathecae resemble those of L. lichyi. It is not keyed in this review.

11. Pleuron completely pale. ..... 12

Pleuron with well pigmented pronotum, at least. ..... 14

12. Head completely pale. Scutum lightly pigmented at sides only. Labrum <0.24 mm long. ..... L. evangelistai (Pl. 12-22)

Head pigmented in part or whole. Scutum entirely well pigmented. Labrum >0.25 mm long. ..... 13

13. Individual sperm ducts relatively thin as shown... L. gomezi (Pl. 12-24)

Individual sperm ducts clearly wider. ..... L. sherlocki (Pl. 12-23)

14. Scutum, pronotum & paratergite will pigmented, remainder of pleuron pale. ..... L. cruciata (Pl. 12-25)

Scutum, pronotum, paratergite, anepisterum, at least, well pigmented. ..... 15

15. Labrum longer than flagellomere I. ..... L. diabolica (Pl. 12-27)

Labrum subequal to, or shorter than, flagellomere I. ..... 16

16. Labrum longer than 0.35 mm. ..... L. bifoliata (Pl. 12-6)

Labrum shorter than 0.30 mm. ..... L. carvalhoi (Pl. 12-20)

Lutzomyia (Lutzomyia) n.sp. #1 (Pl. 12-14)

L. marinkellei (Pl. 12-26)

L. spathotrichia (Pl. 12-19)

## Lutzomyia (Lutzomyia) battistinii (Hertig)

Plate 12-1

Phlebotomus battistinii Hertig 1943: 247 (♂, ♀, Andahuaylas, Apurimac, Peru). Blancas & Herrer 1959-1960: 61 (cf. to bicornutus).

Lutzomyia battistinii: Theodor 1965: 181 (listed). Forattini 1973: 248 (♂ fig., tax.). Martins et al. 1978: 24 (dist., refs.). Llanos 1981: 183 (listed, Peru). Galati et al. 1985: 266 (♂ keyed).

Distribution (Map 12-1). Peru (Hertig 1943; Llanos 1981).

Remarks. The spermathecae of L. battistinii have not been figured previously. They are slender, annulated, without an enlarged terminal annulation, and resemble those of L. renei. The sperm ducts were not visible in the females examined.

Llanos (1981) reported this species from Junin Department, Peru, but did not give a specific locality. Specimens mentioned by Hertig (1943) were found at elevations ranging from 2000 to 2400 m above sea level.

## Lutzomyia (Lutzomyia) forattinii Galati, Rego and Nunes

Plate 12-2

Lutzomyia forattinii Galati, Rego & Nunes 1985: 261 (♂, ♀, Corumba, Mato Grosso do Sul, Brazil).

Distribution (Map 12-2). Brazil (type locality).

Lutzomyia (Lutzomyia) bicornuta (Blancas & Herrer)

Plate 12-3

Phlebotomus bicornutus Blancas & Herrer 1959-1960: 58 (♂, ♀, near Anco, Rio Mantaro, Huancavelica, Peru).

Lutzomyia bicornuta: Theodor 1965: 181 (listed). Forattini 1973: 248 (♂, ♀ figs., tax.). Martins et al. 1978: 24. Llanos 1981: 183 (listed). Galati et al. 1985: 266 (♂ keyed).

Distribution (Map 12-3). Peru (type locality).

Remarks. One of us (D.Y.) examined the holotype and allotype of L. bicornuta at the National Institute of Health, Lima, in 1988. They agree well with the original description and figures. One spermatheca of the allotype was sketched & is shown here (Pl. 12-3).

Lutzomyia (Lutzomyia) cavernicola (Costa Lima)

Plate 12-4

Phlebotomus cavernicola Costa Lima 1932: 49 (♀, Gruta Maquiné, Minas Gerais, Brazil).

Lutzomyia cavernicola: Martins et al. 1961a: 226 (♂ descript., ♀ redescript.). Barretto 1962: 92 (listed). Theodor 1965: 181 (listed).

Forattini 1973: 251 (♂, ♀ figs., tax.). Martins et al. 1978: 24 (♂, ♀ figs., dist.). Galati et al. 1985: 266 (♂ keyed).

Distribution (Map 12-4). Brazil (Martins et al. 1978).

Remarks. Leger et al. (1977) reported L. cavernicola from French Guiana (? ♀), but its presence there is very unlikely and this record is probably a misidentification of another species in the subgenus Lutzomyia.

Lutzomyia (Lutzomyia) renei (Martins, Falcão & Silva)

Plate 12-5

Phlebotomus renei Martins, Falcão & Silva 1957: 322 (♂, Gruta da Lapinha, Lagoa Santa, Minas Gerais, Brazil). Sherlock 1957b: 548 (♀, immatures).

Lutzomyia renei: Barretto 1962: 92 (listed). Theodor 1965: 181 (listed). Coelho et al. 1967a-d (experimental infections with Leishmania). Forattini 1973: 226 (♂, ♀ figs., tax.). Martins et al. 1978: 25 (dist.). Galati et al. 1985: 266 (♂ keyed). Killick Kendrick 1986: 135 (listed). Gontijo et al. 1987: 445 (experimental Leishmania infection in ♂ renei).

Distribution (Map 12-5). Brazil (Martins et al. 1978).

Remarks. Lutzomyia renei has been used as an experimental vector of Leishmania mexicana (as Le. braziliensis) by Coehlo et a. (1962) who later (1967a-d) conducted experimental infection studies using another Leishmania, possibly Le. braziliensis (see Killick Kendrick 1986).

There is no evidence at present that L. renei is a natural vector of Leishmania.

Lutzomyia (Lutzomyia) bifoliata Osorno, Morales, Osorno & Hoyos

Plate 12-6

Lutzomyia bifoliata Osorno, Morales, Osorno & Hoyos 1970: 8 (♂, El Terminal, Puerto Boyacá, Boyacá, Colombia). Forattini 1973: 248 (♂ fig.). Martins et al. 1978: 21 (dist.). Young 1979: 52 (♂, ♀, refs.). Morales et al. 1981: 201 (Mariquita, Tolima, Colombia). Porter & de Foliart 1981: 201 (biting habits). Le Pont & Desjeux 1983: 51 (cf. to eliensis).

Distribution (Map 12-1). Colombia (Young 1979; Morales et al. 1981).

Remarks. The females of L. bifoliata and L. lichyi are anthropophilic; both occur together at Mariquita, Tolima Depto., Colombia, and are separated by the relative lengths of the terminal 2 flagellomeres, i.e., the ultimate flagellomere of L. lichyi is longer than the preceding flagellomere, unlike that of L. bifoliata.

Lutzomyia (Lutzomyia) lichyi (Floch & Abonnenc)

Plate 12-7

Phlebotomus lichyi Floch & Abonnenc 1950a: 1 (♀, Rio Borburata, Carabobo, Venezuela).

Phlebotomus vexillarius Fairchild & Hertig 1952: 514 (♂, ♀, Panama). Floch & Kramer 1965: 1 (as synonym of lichyi).

Phlebotomus foliatus Mirsa & Ortiz 1952: 249 (♂, Venezuela). Fairchild & Hertig 1958b: 205 (as synonym of vexillarius).

Lutzomyia vexillaria: Martins et al. 1963b: 335 (♂, ♀, Brazil).

Lutzomyia lichyi: Barretto 1962: 98 (listed). Forattini 1973: 259 (♂, ♀ figs.). Martins et al. 1976a: 488 (♂, Peru). Mogollon et al. 1977: 209 (Venezuela). Martins et al. 1978: 22 (dist., refs.). Ramirez Perez et al. 1978: 49 (♂, ♀ figs., Aragua, Venezuela). Williams & Carvalho 1979: 329 (cf. to dispar). Young 1979: 54 (♂, ♀ figs., full refs.). Feliciangeli 1980: 246 (figs., keyed). Leger et al. 1980: 117 (French Guiana). Ramirez Perez et al. 1982a: 14 (figs., Sucre, Venezuela); 1982b: 58 (figs., Tachira, Venezuela). Le Pont & Desjeux 1983: 51 (cf. to eliensis). Bonfante Garrido 1984: 850 (Venezuela). Murillo & Zeledón 1985: 36 (♂, ♀ figs., Costa Rica). Young et al. 1987: 588 (negative for flagellates, Colombia). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 12-6). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Morales et al. 1981; Young et al. 1987); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1982a,b; Bonfante Garrido 1984); Trinidad (Young 1979); Brazil (Martins et al. 1963a); Peru (Martins et al. 1976a).

Remarks. The record of L. lichyi in Mato Grosso, Brazil (Lainson et al. 1976) was based on a single female provisionally identified as this species by D. Young. The specimen, however, is conspecific with L. sherlocki.

Hanson (1968) described the fourth instar larva and pupa of L. lichyi (as vexillarius) from specimens reared in Panama. He noted that the larvae of this species and L. gomezi share certain characters not found in any other known species.

## Lutzomyia (Lutzomyia) dispar Martins & Silva

Plate 12-8

Lutzomyia dispar Martins & Silva 1963: 243 (♂, Aquidauana, Mato Grosso, Brazil). Forattini 1973: 254 (♂ fig.). Martins et al. 1978: 21 (dist.). Williams & Carvalho 1979: 325 (♀ descript., ♂ redescript., dist.).

Distribution (Map 12-7). Brazil (Martins et al. 1978).

Remarks. Williams & Carvalho (1979) reported females of L. dispar attacking man during the daytime at Camapua, Mato Grosso, Brazil. Males from there have shorter structures of the terminalia than those of the holotype, but Williams & Carvalho regarded then as representing a single species.

## Lutzomyia (Lutzomyia) ischnacantha Martins, Souza & Falçăo

Plate 12-9

Lutzomyia ischnacantha Martins, Souza & Falção 1962e: 39 (♂ , Lapao, Minas Gerais, Brazil). Theodor 1965: 181 (listed). Forattini 1973: 257 (♂ fig.), Martins et al. 1975c: 298 (♀ descript.); 1978: 21 (dist.). Williams & Carvalho 1979: 329 (cf. to dispar).

Distribution (Map 12-3). Brazil (Martins et al. 1978).

Remarks. Apart from being found in limestone caves, there is no published information on the habits of this species.

## Lutzomyia (Lutzomyia) amarali (Barretto & Coutinho)

Plate 12-9

Phlebotomus amarali Barretto & Coutinho 1940b: 134 (♀, Saõ Paulo, Saõ Paulo, Brazil). Floch & Abonnenc 1952: 47 (♀ keyed, figs.).

Flebotomus amarali: Barretto 1947a: 184 (refs.).

Lutzomyia amarali: Theodor 1965: 196 (listed). Martins et al. 1978: 150 (refs., dist.). Mayrink et al. 1979: 131 (Caratinga, Brazil, infected with gregarines). Aguiar et al. 1985d: 467 (coll. data, Brazil).

Lutzomyia diacantha: Martins & Silva 1965: 273 (♂, Bonito, Minas Gerais, Brazil). Forattini 1973: 254 (♂ fig.). Martins et al. 1978: 150 (as synonym of amarali, dist.).

Brumptomyia amarali: Forattini 1971a: 98 (listed); 1973: 523 (♀ figs.).

Distribution (Map 12-3). Brazil (Martins et al. 1978).

Remarks. The unusual arrangement of the cibarial teeth and the shape of the spermathecae of L. amarali resemble those of the Brumptomyia females but the interocular suture is incomplete in both sexes and the L. amarali male differs greatly from those in the genus Brumptomyia.

Lutzomyia (Lutzomyia) cruzi (Mangabeira)

Plate 12-10

Flebotomus cruzi Mangabeira 1938: 351 (♂, Camapuan, Mato Grosso do Sol, Brazil) Barretto 1947a: 195 (refs.).

Lutzomyia cruzi: Barretto 1962: 92 (listed). Forattini 1973: 252 (♂ fig., tax.). Martins et al. 1978: 21 (dist.); 1984: 439 (♂ redescript., ♀ descript.). Galati et al. 1985: 261 (Mato Grosso do Sol, Brazil).

Distribution (Map 12-8). Brazil (Martins et al. 1978; 1984; Galati et al. 1985).

Remarks. The females of L. cruzi and L. longipalpis are structurally indistinguishable (Martins et al. 1984) but little is known about the habits of the former species. The male of L. cruzi has 4 foliaceous setae at the inner base of the coxite, not 6 as Mangabeira (1938) described.

## Lutzomyia (Lutzomyia) souzalopesi Martins, Silva & Falção

Plate 12-10

Lutzomyia souzalopezi Martins, Silva & Falção 1970b: 559 (♂, ♀, Aracruz, Espirito Santo, Brazil). Forattini 1973: 270 (♂, ♀ figs.). Martins et al. 1978: 24.

Distribution (Map 12-1). Brazil (type locality).

Remarks. This species, known only from the type series, was collected from tree trunks at Aracruz, Brazil.

## Lutzomyia (Lutzomyia) longipalpis (Lutz & Neiva)

Plate 12-11

Phlebotomus longipalpis Lutz & Neiva 1912: 89 (♂, ♀, Brazil, specific locality not known). Guitton & Sherlock 1969: 383 (immature stages).

Phlebotomus otamae Nunez-Tovar 1924: 44 (♂, Isla de Otama, Carabobo, Venezuela).

Phlebotomus almazani Galliard 1934: 193 (♀, Chichen Itza, Yucatan, Mexico).

Flebotomus longipalpis: Barretto 1947a: 208 (full refs.).

Lutzomyia longipalpis: Theodor 1965: 181 (♂, ♀ figs.). Forattini 1973: 213 (♂, ♀, immatures, figs., gen. review). Ward & Ready 1975: 128 (egg descript.). Lainson et al. 1977: 628 (experimental vector, Leishmania chagasi). Mogollon et al. 1977: 209 (Venezuela record). Ready 1978: 545 (lab feeding habits). Ramirez Perez 1978: 49 (figs., Venezuela). Martins et al. 1978: 22 (♂, ♀ figs., dist., refs.). Young 1979: 56 (figs., refs.). Ready 1979: 413 (physiol., egg production). Lainson et al. 1979: 309 (experimental host, Leishmania). Shaw 1981: 232 (experimental host, Endotrypanum). Killick Kendrick & Molyneux 1981: 152 (mouthpart sensilla). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Araujo & Sherlock 1981: 81 (Ilha Grande, brazil). Rudin & Hecker 1982: 751 (functional gut morphol.). Buescher et al. 19: 176-180 (repellent testing). Ramirez Perez et al. 1982a: 14 (figs., Venezuela). Modi & Tesh 1983: 568 (lab rearing). Lainson et al. 1983: 323 (Marajo Island, Brazil). McMahon Pratt et al. 1983: 1268 (detection of Leishmania amazonensis by monoclonal antibodies). Tesh & Modi 1983: 199 (in vitro cell line developed). Bonfante Garrido 1983: 740 (experimental host, Leishmania venezuelensis). Desjeux et al. 1983: 851 (Bolivia). Ward et al. 1983: 269 (cross breeding, variants of longipalpis). Le Pont & Desjeux 1984: 277 (Bolivia). Magnarelli et al. 1984: 681 (age grading). Ryan et al. 1984: 547 (nat. Leishmania infection, Pará, Brazil). Ryan & Brazil 1984: 383 (nat. Leishmania infection, Maranhao, Brazil). Travassos et al. 1984: 1000 (experimental

vesiculovirus infections). Tesh & Modi 1984: 1007 (experimental Phlebotomus infections). Buescher et al. 1984: 76 (multiple feeding, lab ♀♀). Hoch et al. 1984: 295 (experimental host of Rift Valley Fever Virus). Lane & Ward 1984: 245 (tergal spots). Feliciangeli et al. 1984: 360 (Venezuela). Lane et al. 1985: 225 (tergal spots as possible pheromone release sites). Navin et al. 1985: 1074 (Honduras). Murillo & Zeldón 1985: 36 (♂, ♀ figs., Costa Rica). Ward et al. 1985: 145 (dist. of 1 & 2 tergal spot forms). Sacks & Perkins 1985: 456 (experimental host of Leishmania). Killick Kendrick 1985: 751 (experimental & natural vector, Leishmania). Anez et al. 1985: 113 (experimental host, Leishmania). Lainson et al. 1985: 223 (natural Leishmania chagasi infections, Brazil). Le Pont & Desjeux 1985: 227 (natural Leishmania chagasi infections, Bolivia). Cuba Cuba et al. 1985: 503 (experimental host, Leishmania). Goncalves et al. 1985: 337 (experimental vector, Leishmania). Phillips et al. 1986: 271 (compounds in tergal spots). Ribeiro et al. 1986: 271 (capillary feeding). Bonnefoy et al. 1986: 213 (isozyme study). Killick Kendrick 1986: 135 (listed). Braga et al. 1986: 143 (natural Leishmania chagasi infections, Brazil). Jefferies 1987: 444 (mouthpart sensilla). Ribeiro 1987: 471 (salivary gland components). Aguilar et al. 1987: 143 (experimental infections, Leishmania braziliensis). Kreutzer et al. 610 (brain cell karyotypes). Young et al. 1987: 588 (Norte de Santander, Colombia). Young & Lawyer 1987: 49 (2 tergal spot ♀♀, Paraguay). Rangel et al. 1987: 385 (biology). Lainson et al. 1987: 421 (experimental data, transmission of Leishmania chagasi). Wermelinger et al. 1987: 441 (lab rearing).

Distribution (Map 12-9). Mexico to Argentina (Martins et al. 1978) with following additions: Honduras (Navin et al. 1985); Nicaragua (Le Pont et al. 1987); Costa Rica (Murillo & Zeledón 1985); Panama (1 ♂, 7 ♀♀, Toboga Island, light traps, 1953-1954, F. Blanton); Colombia (Young et al. 1987). Other records, published since Martins et al. (1978) and cited here, are included in Map 12-9.

Remarks. Lutzomyia longipalpis is a proven vector, and possibly the only vector, of Leishmania chagasi in the Americas. It is not yet certain, however, whether this species represents a complex of two or more taxa. The discovery of males with two pale spots on abdominal tergites 3 & 4 in Ceará, Brazil (Mangabeira 1969; Ward et al. 1983) and subsequent crossbreeding tests with 1 "tergal spot" forms (Ward et al. 1983), suggest possible interspecific variation. Ward et al. (1985) and Young & Lawyer (1987) report the known distribution of the 2 tergal spot forms in Brazil and Paraguay, respectively.

Laboratory bred L. longipalpis have transmitted other suprapylarian Leishmania by bite, including Le. amazonensis (Killick-Kendrick et al. 1977) and Le. mexicana (Coehlo & Falcão 1962). This sand fly, however, is not a natural vector of these organisms. Other experimental work involving L. longipalpis as an experimental host for Leishmania has provided information on the identity of little-known parasites (e.g., Le. peruviana being a probably member of the subgenus Viannaia).

Recent references given in this account can be consulted for full information on the biology, distribution and disease relationships of this well studied sand fly. In addition, Forattini (1973) summarizes such information up to that date.

Lutzomyia (Lutzomyia) gaminarai (Cordero, Vogelsang & Cossio)

Plate 12-12

Phlebotomus gaminarai Cordero, Vogelsang & Cossio 1928: 649 (♂, ♀, Salto & Tacuarembó, Uruguay, type locality indeterminate).

Flebotomus gaminarai: Barretto 1947a: 201 (refs.).

Lutzomyia gaminarai: Martins et al. 1961c: 312 (♂ redescript.). Forattini 1973: 255 (♂ fig.). Martins et al. 1978: 21 (dist.).

Distribution (Map 12-6). Brazil; Uruguay (Martins et al. 1978).

Remarks. We have not seen the original description of L. gaminarai but Martins et al. (1961c) carefully redescribed the male. The female according to Forattini (1973) is unrecognizable based on the original description.

Lutzomyia (Lutzomyia) ischyracantha Martins, Falção & Silva

Plate 12-13

Lutzomyia ischyracantha Martins, Falção & Silva 1962a: 227 (♂, ♀, Rio Manso, Minas Gerais, Brazil). Forattini 1973: 259 (♂, ♀ figs.). Martins et al. 1978: 21 (dist.). Mayrink et al. 1979: 130 (Minas Gerais, Brazil, biting man in day).

Distribution (Map 12-6). Brazil (Martins et al. 1978).

Lutzomyia (Lutzomyia) alencari Martins, Souza & Falcao

Plate 12-13

Lutzomyia alencari Martins, Souza & Falcao 1962e: 42 (♂, Jequitinhonha, Minas Gerais, Brazil). Theodor 1965: 181 (listed). Forattini 1973: 247 (♂ fig.). Martins et al. 1978: 21 (dist.); 1982: 421 (♀ descript.).

Distribution (Map 12-7). Brazil (Martins et al. 1978).

Remarks. The male of L. alencari has a pale tergal spot on each side of abdominal tergite 4, indicating among other character states, its close resemblance to L. longipalpis.

Lutzomyia (Lutzomyia) n.sp. #1

Plate 12-14

Lutzomyia gomezi (not gomezi Nitz., in part): Young & Rogers 1984: 599 (listed, Napo Prov., Ecuador).

Distribution (Map 12-10). Colombia (♂♂, ♀♀, Leticia, Amazonas, 1986-1987, light traps, A. Morales, C. Ferro & D.G. Young): Brazil (♂♂, ♀♀, 26 km-50 km E of Manaus, Amazonas, 1975-1978, J. Arias & R. Freitas); Ecuador (1 ♂, Limoncocha, Napo, 1976, light trap, D.G. Young).

Remarks. So far, this undescribed species is the only member of the cruciata complex in which the male has 1-2 isolated setae on the dorsal margin of each paramere. Both sexes resemble L. cruciata in other structures but L. (Lutzomyia) n.sp. #1 is generally darker.

Lutzomyia (Lutzomyia) caligata Martins, Falcao & Silva

Plate 12-15

Lutzomyia caligata Martins, Falcao & Silva 1965: 7 (♂, Nucleo Agricola Iata, Rondonia, Brazil). Forattini 1973: 349 (♂ fig). Martins et al. 1978: 150 (listed). Biancardi et al. 1982: 168 (listed).

Distribution (Map 12-2). Brazil (type locality).

Remarks. We have not examined specimens of this little-known species that was described from a single male. Its placement in the subgenus Lutzomyia is provisional.

## Lutzomyia (Lutzomyia) castroi (Barretto & Coutinho)

Plate 12-15

Phlebotomus castroi Barretto & Coutinho 1941b: 180 (♂, Itaporanga, Sao Paulo, Brazil).

Flebotomus castroi: Mangabeira 1942a: 185 (as type species of Phlebotomus subgenus Castromyia). Barretto 1947a: 192 (refs.).

Lutzomyia castroi: Barretto 1962: 92 (mention). Theodor 1965: 191 (listed). Martins & Silva 1968: 3. Forattini 1973: 351 (♂ fig.). Martins et al. 1978: 151 (listed).

Distribution (Map 12-2). Brazil (type locality).

Remarks. The male of L. castroi closely resembles that of L. caligata and, like it, is known only from the type locality. Also, its placement in this subgenus is not definite.

Lutzomyia (Lutzomyia) cipoensis Martins, Falcão & Silva

Plate 12-16

Lutzomyia cipoensis Martins, Falcão & Silva 1964a: 312 (♂, Serra do Cipo, Minas Gerais, Brazil). Forattini 1973: 252 (♂ fig., as possible variant of gasparviannai). Martins et al. 1975c: 297 (♀ descript.); 1978: 160.

Distribution (Map 12-11). Brazil (type locality).

Lutzomyia (Lutzomyia) gasparviannai Martins, Godoy & Silva

Plate 12-17

*Lutzomyia gasparviannai Martins*, Godoy & Silva 1962a: 86 (♂, ♀, Tinguá, Rio de Janeiro, Brazil). Forattini 1973: 255 (♂, ♀ figs., tax.). Martins et al. 1978: 160 (dist., ♂, ♀ figs.). Mayrink et al. 1979: 131 (attracted to man & rodents, Minas Gerais, Brazil). Falqueto et al. 1985: 497 (in Disney traps, Espirito Santo, Brazil).

Distribution (Map 12-12). Brazil (Martins et al. 1978; Falqueto et al. 1985).

Remarks. The presence of 2 large horizontal teeth in the female cibarium of L. gasparviannai is distinctive and readily serves to separate it from the female of L. cipoensis, a close ally.

Falqueto et al. (1985) suggest that this species is a probable vector of Leishmania in Espirito Santo State, Brazil).

Lutzomyia (Lutzomyia) flabellata Martins & Silva

Plate 12-18

Lutzomyia flabellata Martins & Silva 1964: 133 (♂, Rio Branco, Acre, Brazil). Forattini 1973: 352 (♂ fig.). Martins et al. 1978: 160 (listed). Biancardi et al. 1982: 171 (Rondonia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil).

Distribution (Map 12-11). Brazil (Martins et al. 1978; Biancardi et al. 1982;

♂♂, Aripuana, Mato Grosso, J. Arias).

Remarks. The pleuron of L. flabellata is very dark, like that of L. marinkellei, L. araracuarensis and several other species in the cruciata complex. The female remains undescribed.

Lutzomyia (Lutzomyia) spathotrichia Martins, Falcao & Silva

Plate 12-19

Lutzomyia spathotrichia Martins, Falcão & Silva 1963: 340 (♂, Pissarreira, Roraima, Brazil). Forattini 1973: 355 (♂ fig.). Martins et al. 1978: 160 (dist.). Ryan et al. 1986: 28 (Pará, Brazil). Ryan 1986: 50 (♂ fig., ♀ descript., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident., as senior synonym of L. eliensis).

Lutzomyia eliensis Le Pont & Desjeux 1983: 48 (♂, ♀, St. Elie, French Guiana). Geoffroy et al. 1986: 486 (French Guiana).

Distribution (Map 12-2). French Guiana (Le Pont & Desjeux 1983); Brazil (Martins et al. 1978; Ryan 1986).

Remarks. From the description of L. eliensis Le Pont & Desjeux (1983), there is little doubt about its conspecificity with L. spathotrichia. The female illustrated here (Pl. 12-19) was captured on human bait in the forest canopy, Rio Jari, Pará, Brazil, by P.D. Ready.

### Lutzomyia (Lutzomyia) carvalhoi (Damasceno, Causey & Arouck)

Plate 12-20

Flebotomus carvalhoi Damasceno, Causey & Arouck 1945: 8 (♂, Tocunduba, Belém, Pará, Brazil).

Phlebotomus carvalhoi: Fauran 1960: 7 (♂ figs., French Guiana).

Lutzomyia carvalhoi: Theodor 1965: 182. Forattini 1973: 349 (♂ fig., tax.). Legér et al. 1977: 219 (French Guiana). Martins et al. 1978: 159 (dist.). Ryan 1986: 44 (♂ fig., ♀ descript., Pará, Brazil). Ryan et al. 1987a: 356 (natural flagellate infection; Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 12-11). French Guiana (Fauran 1960); Brazil (Martins et al. 1978; Ryan 1986).

Remarks. Ryan (1986) observed that the L. carvalhoi female lacks a common sperm duct unlike that of L. spathotrichia in which there is a short duct. Also, the spermathecal annulations are distinct in the former species but indistinct or incomplete in L. spathotrichia.

Lutzomyia (Lutzomyia) araracuarensis Morales & Minter

Plate 12-21

Lutzomyia araracuarensis Morales & Minter 1981: 98 (♂, Araracuara, Caqueta, Colombia).

Distribution (Map 12-12). Colombia (Morales & Minter 1981; ♂♂, Leticia, Amazonas, 1986-1987, A. Morales, C. Ferro, D.G. Young).

Remarks. The female of this species is unknown but probably resembles L. spathotrichia in color and structure.

Lutzomyia (Lutzomyia) evangelistai Martins & Fraiha

Plate 12-22

Lutzomyia evangelistai Martins & Fraiha 1971: 361 (♂, ♀, Belém, Pará, Brazil). Llanos et al. 1975a: 659 (♀, cf. to sherlocki); 1976: 480 (Peru). Martins et al. 1978: 122 (dist.). Fraiha et al. 1980b: 21 (Iquitos, Peru ). Llanos 1981: 183 (listed). Biancardi et al. 1982: 168 (Rondonia, Brazil). Le Pont & Desjeux 1983: 51 (cf. to eliensis). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 46 (♂, ♀ figs.). Young & Morales 1987: 662 (Amazonas, Colombia).

Distribution (Map 12-5). Brazil (Martins & Fraiha 1971; Biancardi et al. 1982); Colombia (Young & Morales 1987); Peru (Llanos et al. 1976; Fraiha et al. 1980); Bolivia (♀, Rio Yapancani, Santa Cruz, 1983, light trap, H. Bermudez & D.G. Young).

Remarks. Except for a lateral band of faint pigmentation on each side of the scutum, this species is conspicuously pale. The record from Bolivia, where L. evangelistai has not been previously collected, suggests that this is a widespread species.

## Lutzomyia (Lutzomyia) sherlocki Martins, Silva & Falção

Plate 12-23

Lutzomyia sherlocki Martins, Silva & Falção 1971: 415 (♂, Vila Bela, Mato Grosso, Brazil). Llanos et al. 1975a: 657 (♀ descript., Peru); 1976b: 671 (Peru). Martins et al. 1978: 124 (dist.). Biancardi et al. 1982: 170 (Rondonia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Le Pont & Desjeux 1983: 51 (cf. to eliensis).

Lutzomyia lichyi (not lichyi Floch & Abonnenc): Lainson et al. 1976: 57 (Mato Grosso, Brazil).

Lutzomyia gomezi (not gomezi Nitz. in part). Young 1979: 59 (♀, not ♂, Leticia, Colombia). Young & Rogers 1984: 599 (listed, Napo, Ecuador).

Distribution (Map 12-4). Colombia (Young 1979: ♀♀, Leticia, Amazonas, 1986-1987, A. Morales, C. Ferro & D.G. Young). Ecuador (♀♀, Limoncocha,

Napo, May 1976, light trap, D.G. Young & T. Rogers). Peru (Llanos 1975a,b); Brazil (Lainson et al. 1976; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982); Bolivia (1 ♂, Rio Yapacani, Santa Cruz, May 1983, light trap, H. Bermudez & D.G. Young).

Remarks. Martins et al. (1971) distinguish the males of L. sherlocki from L. gomezi by the greater number of setae at the coxite base (40 for sherlocki vs. 14-19 for gomezi). The female of L. sherlocki has larger spermathecae than those of L. gomezi according to Llanos et al. (1975a).

It should also be pointed out that the individual sperm ducts of L. sherlocki are wider than those of L. gomezi (cf. Pl. 12-23 & 12-24), but the female of the latter species has a longer labrum ranging from 0.31 to 0.36 mm (n = 35 from Trinidad, Venezuela, Colombia, Ecuador, Panama, Costa Rica, and Nicaragua). All females examined form the Amazon basin of Brazil (n = 20), Ecuador (n = 2) and Leticia, Colombia (n = 6) have shorter labra, ranging from 0.24 to 0.29 mm in length. These females also have wide individual sperm ducts, as figured by Ryan (1986).

Our sample representation is hardly sufficient to draw conclusions regarding the status of L. sherlocki as a valid species, distinct from L. gomezi. The males of L. gomezi and L. sherlocki are very similar in structure but that of L. sherlocki has more setae on the paramere which, in addition, is more upturned & tapered towards its apex. The number of setae of the coxite tuft is difficult to count, but we have examined several males from Tucurui, Pará, Brazil, that have 25-35 such setae.

Additional studies are needed to determine whether these differences reflect clinal variation and to obtain a better picture of the geographic ranges of these forms.

Lutzomyia (Lutzomyia) gomezi (Nitzulescu)

Plate 12-24

Phlebotomus gomezi Nitzulescu 1930: 247 (♀, San Cristobal, Tachira, Venezuela). Fairchild & Hertig 1948a: 252 (tax.); 1953b: 382 (♂♀ figs., refs., dist.). Fairchild & Hertig 1948a: 252 (as junior synonym of gomezi). Hanson 1968: 60 (larva, pupa).

Phlebotomus suis Rozeboom 1940: 8 (♂, ♀, Panama). Fairchild & Hertig 1948a: 252 (as junior synonym of gomezi).

Phlebotomus japignyi Floch & Abonnenc 1944c: 2 (♂, ♀, French Guiana). Fairchild & Hertig 1948a: 252 (as junior synonym of gomezi).

Lutzomyia gomezi: Martins et al. 1962b: 90 (cf. to gasparvianna). Forattini 1973: 240 (figs., tax., gen. review). Intermill & Muller 1976: 543 (Honduras). Zimmerman et al. 1977: 595 (egg). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 122 (♂, ♀ figs., refs., dist.). Ramirez Perez et al. 1978: 65 (figs., Aragua, Venezuela). Young 1979: 56 (figs., refs.). Christensen & Herrer 1980a: 88 (experimental infections with Leishmania aristidesi); 1980b: 523 (feeding habits). Feliciangeli 1980: 246 (keyed, figs.). Fraiha et al. 1980b: 21 (Peru). Leger et al. 1980: 116 (French Guiana). Porter & De Foliart 1981: 144 (ecology, biting activity,

Colombia). Morales & Minter 1981: 96 (Caqueta, Colombia). Morales et al. 1981: 198 (Tolima, Colombia). Ramirez Perez et al. 1981: 114 (pop. dynamics, age grading); 1982a: 14 (Sucre, Venezuela); 1982b: 58 (figs., Tachira, Venezuela). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Le Pont & Desjeux 1983: 51 (cf. to eliensis). Bonfante Garrido 1983: 740; 1984: 850 (Venezuela). Hashiguchi et al. 1985a: 442 (Ecuador). Murillo & Zeledón 1985: 34 (♂, ♀ figs., Costa Rica). Ready et al. 1986: 36 Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 47 (figs., Pará, Brazil). Young et al. 1987: 588 (nat. promastigote infection, Colombia). Alexander 1987: 554 (dispersal). Feliciangeli 1987a-d (ecology, Carabobo, Venezuela).

Distribution (Map 12-3). Honduras (Intermill & Muller 1976); El Salvador; Nicaragua (Martins et al 1978); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979, in part; Morales & Minter 1981; Morales et al. 1981; Young et al. 1987); Ecuador (Young & Rogers 1984, in part); Hashiguchi et al. 1985a); Peru (Martins et al. 1978; Fraiha et al. 1980b; Llanos 1981); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978; 1982a,b; Bonfante Garrido 1983; Feliciangeli 1987a); Trinidad (Martins et al. 1978); French Guiana (Leger et al. 1977; Martins et al. 1978); Brazil (Martins et al. 1978, ? in part).

Remarks. As discussed under L. sherlocki, we suspect that some published records in L. gomezi in the Amazon basin of Brazil and southwards may represent L. sherlocki or, at least, atypical forms of L. gomezi (♀♀ with wide sperm ducts).

Females from Trinidad, western Ecuador, western and northern Colombia, and Central America are structurally similar to those figured by Fairchild & Hertig (1953b) and also to specimens captured within 150 km of the type locality in Venezuela (D.G. Young, unpub. data). We have not seen females from French Guiana but, based on the description and illustrations of Floch & Abonnenc (1944c, 1952, as japignyi), their material can be assigned to L. gomezi (♀♀ with thin sperm ducts). Females from Pará State, Brazil, that we examined (Belem, n = 10; Maraba, n =2) correspond to the wide duct form which, we suspect, is conspecific with L. sherlocki.

The habits of "typical" L. gomezi have been studied by several investigators, including Porter & De Foliart (1981) in Colombia. They noted that man-biting activity was greater near forest clearings at stations in the forest canopy. Most females, in or near such clearings, bit the collectors from 1800-2000 hrs. No such pattern was observed at a deep forest site.

Lutzomyia gomezi feeds on a variety of mammals and is a suspected vector of Leishmania panamensis in Panama (see Christensen et al. 1983 for refs. & additional information).

## Lutzomyia (Lutzomyia) cruciata (Coquillett)

Plate 12-25

Flebotomus cruciatus Coquillett 1907: 102 (♀, Trece Aguas, Alta Vera Paz, Guatemala). Barretto 1947a: 194 (full refs.).

Phlebotomus cruciatus: Fairchild & Hertig 1948a: 247 (♀, tax., refs.); 1953b: 377 (figs., tax.).

Lutzomyia cruciata: Theodor 1965: 182 (figs., listed). Martins et al. 1978: 121 (in part, dist.). Lewis & Macfarlane 1981: 179 (mite parasite, Belize). Zeledón et al. 1982: 276 (Honduras). Zeledón & Murillo 1983: 280 (Nicaragua). Le Pont & Desjeux 1983: 51(cf. to eliensis). Young & Perkins 1984: 269 (figs., refs., tax.). Murillo & Zeledón 1985: 31 (figs., Costa Rica). Porter et al. 1987: 929 (age grading, Guatemala). Endris et al. 1987: 413 (egg).

Distribution (Map 12-7). U.S.A. (Young & Perkins 1984); Mexico (Martins et al. 1978, in part; Young & Perkins 1984); Belize (Martins et al. 1978); Guatemala (type locality; Young & Perkins 1984; Porter et al. 1987); Honduras; El Salvador; Nicaragua; Panama (Martins et al. 1978; Young & Perkins 1984); Costa Rica (Murillo & Zeledón 1985).

Remarks. Lutzomyia cruciata can be distinguished rapidly from L. gomezi in Central America by coloration. The pronotum and paratergite of L. cruciata are heavily pigmented but are pale in the latter species.

There is increasing evidence indicating that a high proportion of L. cruciata females are autogenous (Young & Perkins 1984; Porter et al. 1987). Females will attack man, however, and experimental transmission of Leishmania mexicana has been demonstrated in Belize (see Williams 1970).

## Lutzomyia (Lutzomyia) marinkellei Young

Plate 12-26

Lutzomyia marinkellei Young 1979: 59 (♂, ♀, Tres Esquinas, Caqueta, Colombia). Morales & Minter 1981: 96 (Caqueta, Colombia). Biancardi et al. 1982: 170 (Rondonia, Brazil). Le Pont & Desjeux 1983: 51 (cf. to eliensis).

Distribution (Map 12-7). Colombia (Young 1979; Morales & Minter 1981; 4 ♂♂, Leticia, Amazonas, 1986, A. Morales); Brazil (Young 1979; Biancardi et al. 1982).

## Lutzomyia (Lutzomyia) diabolica (Hall)

Plate 12-27

Phlebotomus sp. Parman 1919: 211 (biting man, U.S.A.).

Phlebotomus diabolicus Hall 1936: 28 (♂, ♀, Uvalde, Texas, U.S.A.). Fairchild & Hertig 1948a: 25 (cf. to gomezi & cruciata); 1953b: 375 (figs., tax.).

Lutzomyia diabolica: Theodor 1965: 182 (listed). Young & Perkins 1984: 270 (figs., refs., dist.). Lawyer 1984: 1 (biology, disease relationships). Gustafson et al. 1985: 58 (mention). Lawyer & Young 1987: 458 (experimental vector of Leishmania mexicana). Lawyer et al. 1987: 347 (experimental host of Leishmania mexicana). Endris et al. 1987: 413 (egg structure).

Lutzomyia cruciata diabolica: Lewis 1975a: 509 (mouthpart morphol.).

Distribution (Map 12-8). U.S.A.: Mexico (Young & Perkins 1984).

Remarks. Lutzomyia diabolica is a suspected vector of Leishmania mexicana in southern Texas and northern Mexico and has been experimentally infected with Leishmania infantum (see Young & Lawyer 1987). Information and references pertaining to the biology and Leishmania relationships of this anthropophilic species are provided by Lawyer (1984), Lawyer & Young (1987), and Lawyer et al. (1987). Earlier records of L. cruciata in Texas, U.S.A., refer instead to L. diabolica (Young & Perkins 1984).

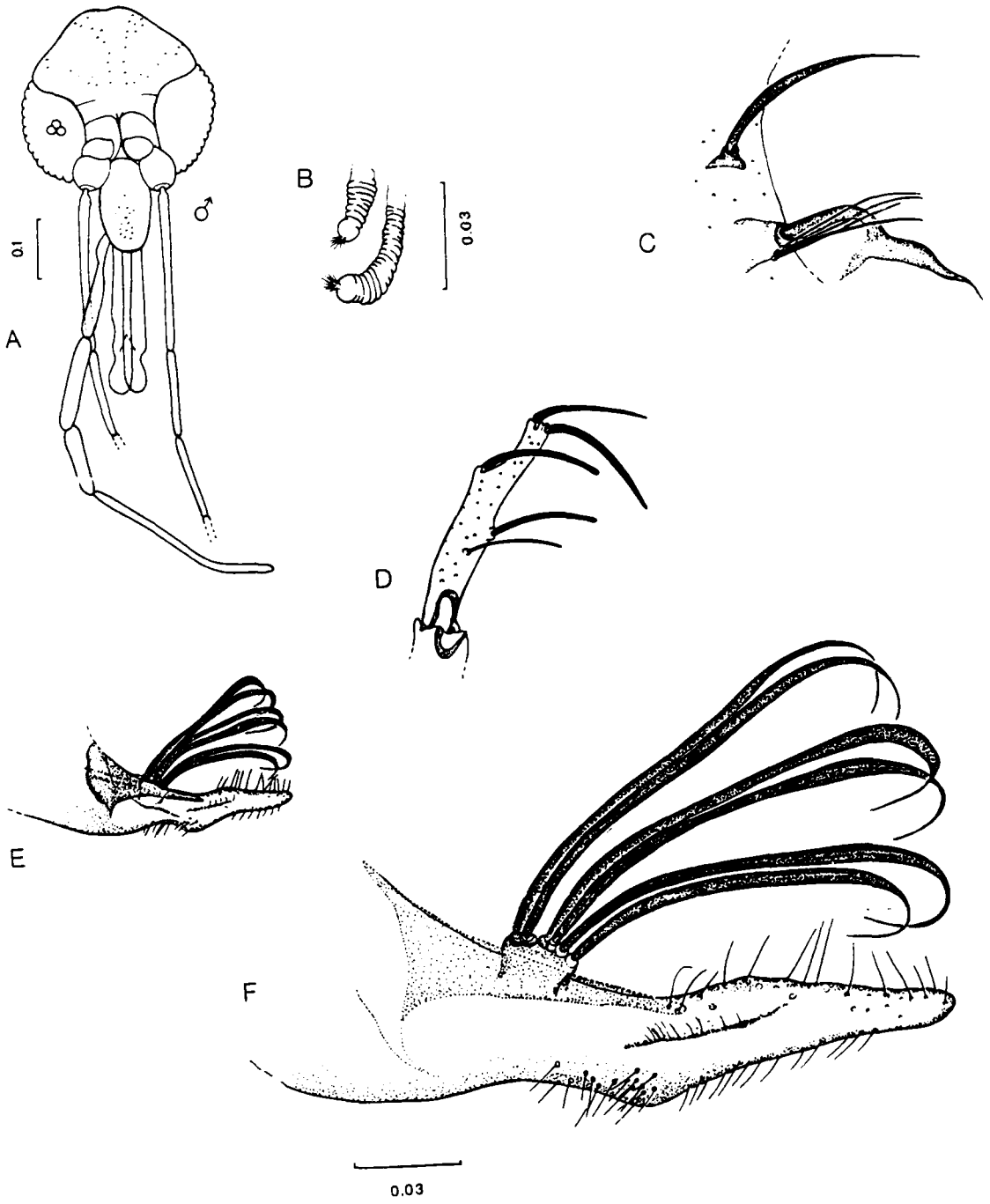



Plate 12-1

Lutzomyia battistinii. A. Male head; B. Spermathecae; C. Persistent setae at coxite base; D. Style; E. Paramere; F. Paramere

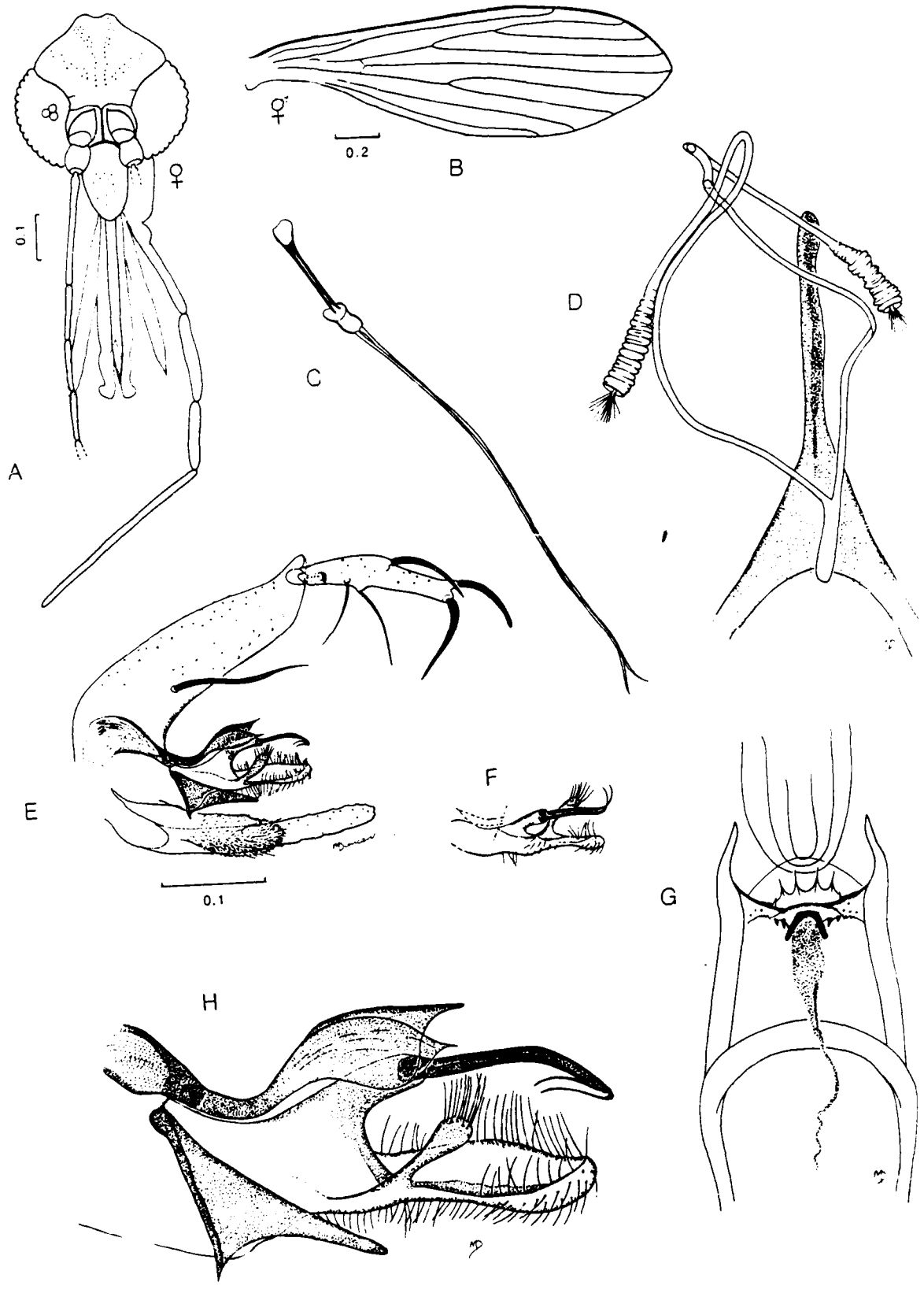



Plate 12-2

Lutzomyia forattinii. A. Female head; B. Female wing; C. Genital pump & filaments; D. Spermathecae; E. Male terminalia; F. Paramere; G. Female cibarium; H. Paramere.

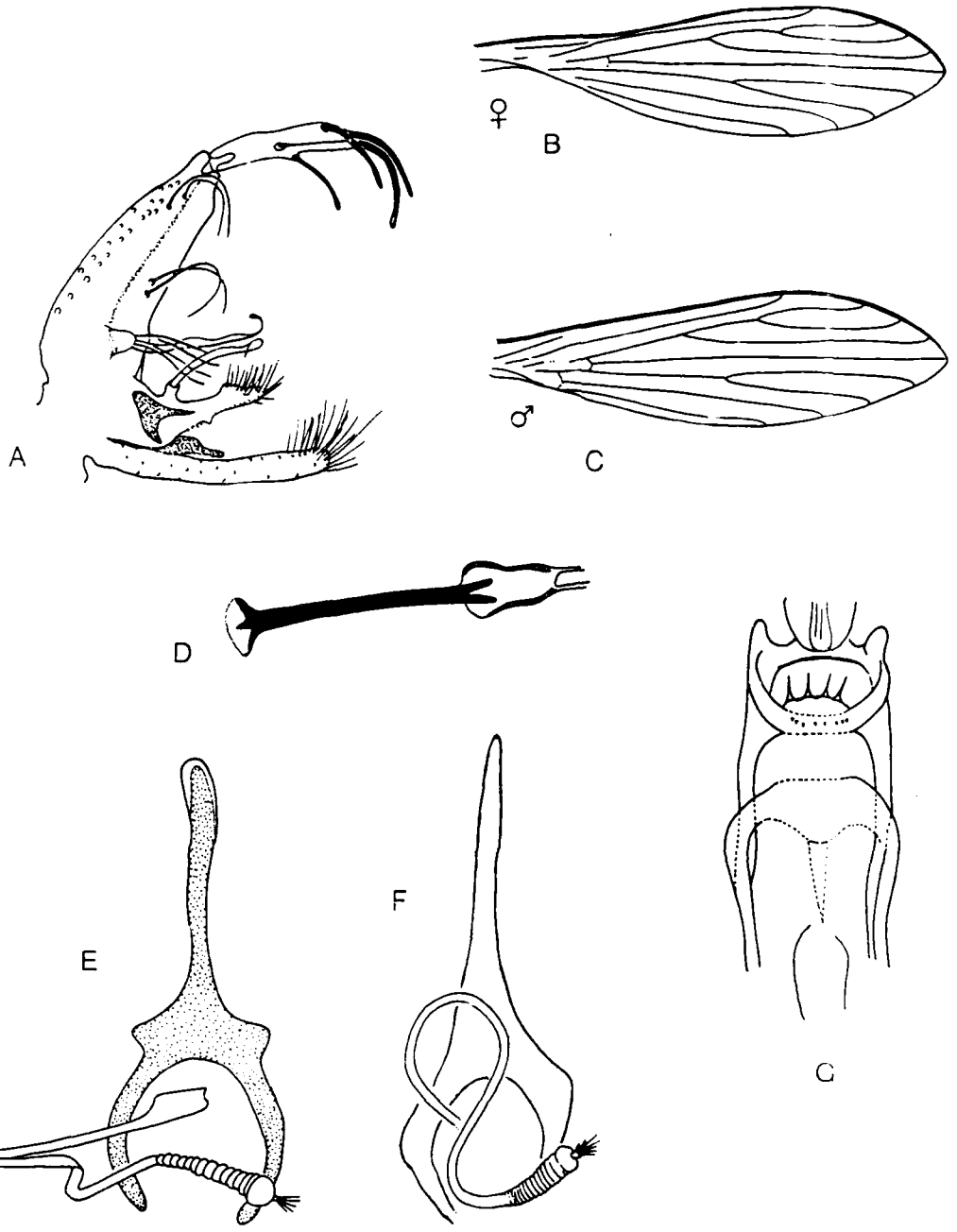



Plate 12-3

Lutzomyia bicornuta. A. Male terminalia; B. Female wing; C. Male wing; D. Genital pump; E. Spermathecae; F. Spermathecae (sketched from allotype); G. Female cibarium (all figs. except F from Blancas & Herrer 1959-1960).

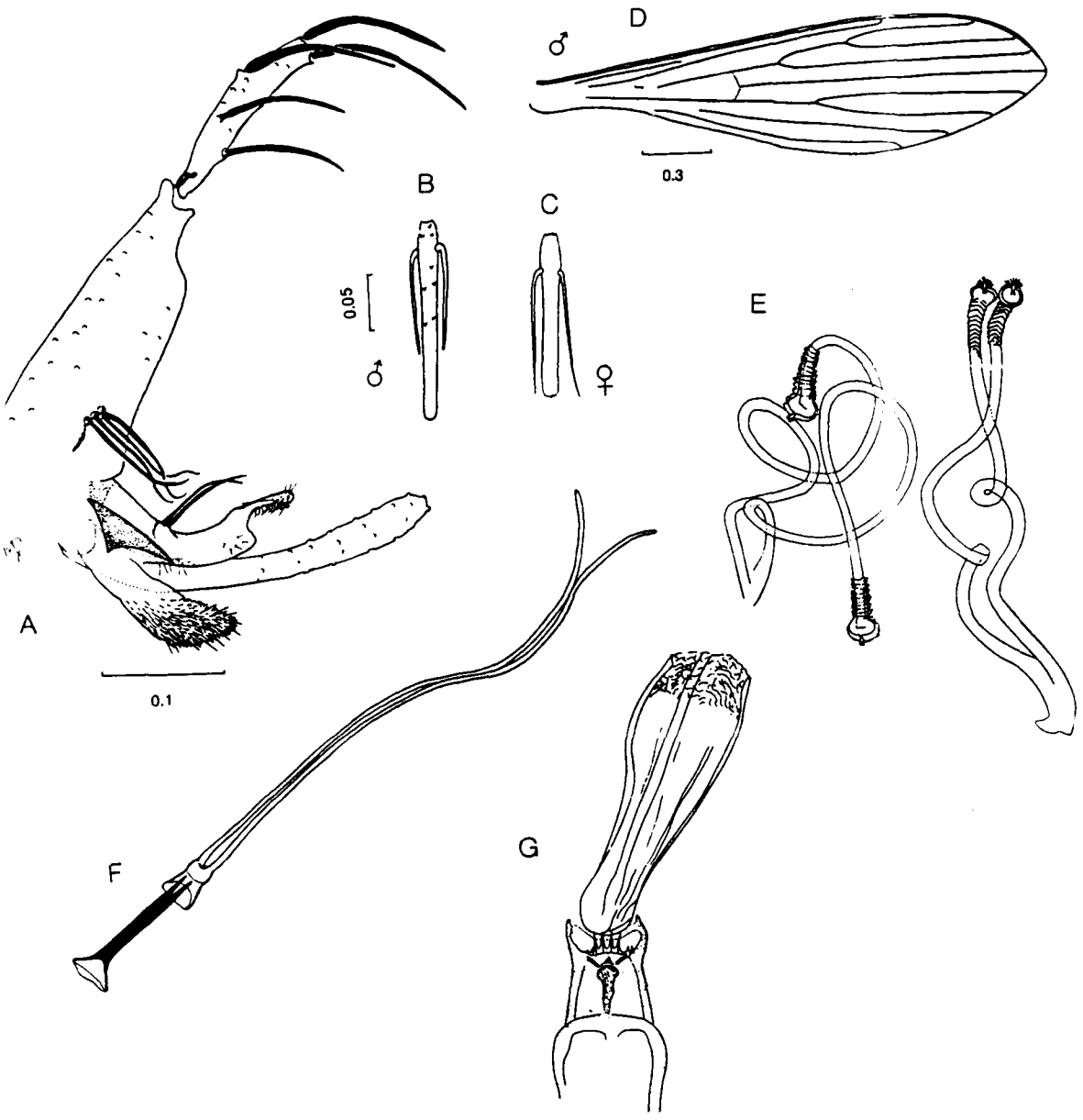



Plate 12-4

Lutzomyia cavernicola. A. Male terminalia; B. Male flagellomere II; C. Female flagellomere II; D. Male wing; E. Spermathecae; F. Genital pump & filaments; G. Female cibarium & pharynx (figs. C, E, & G from Martins et al. 1961a).

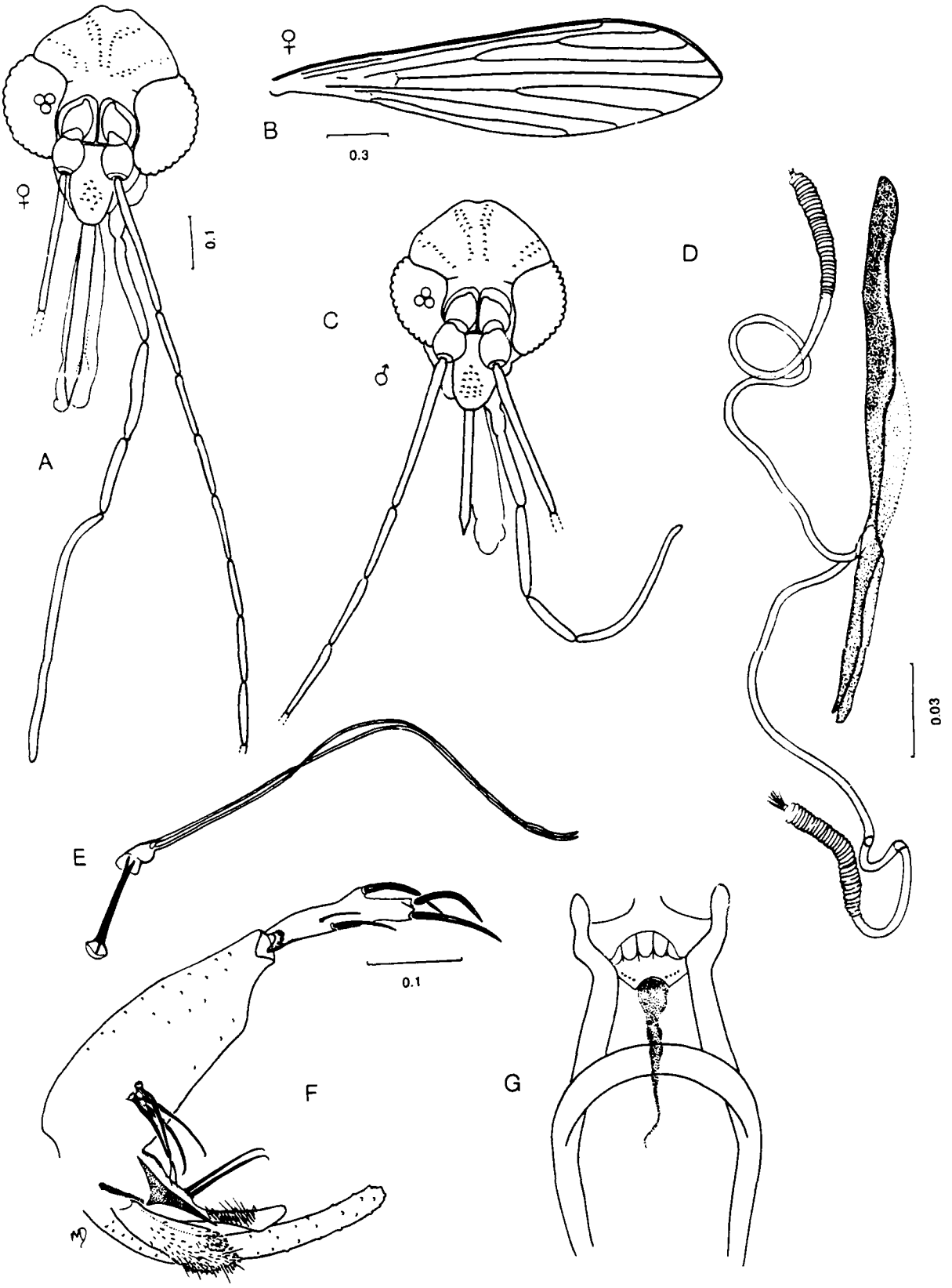



Plate 12-5

Lutzomyia renei. A. Female head; B. Female wing; C. Male head; D. Spermathecae; E. Genital pump & filaments; F. Male terminalia; G. Female cibarium.

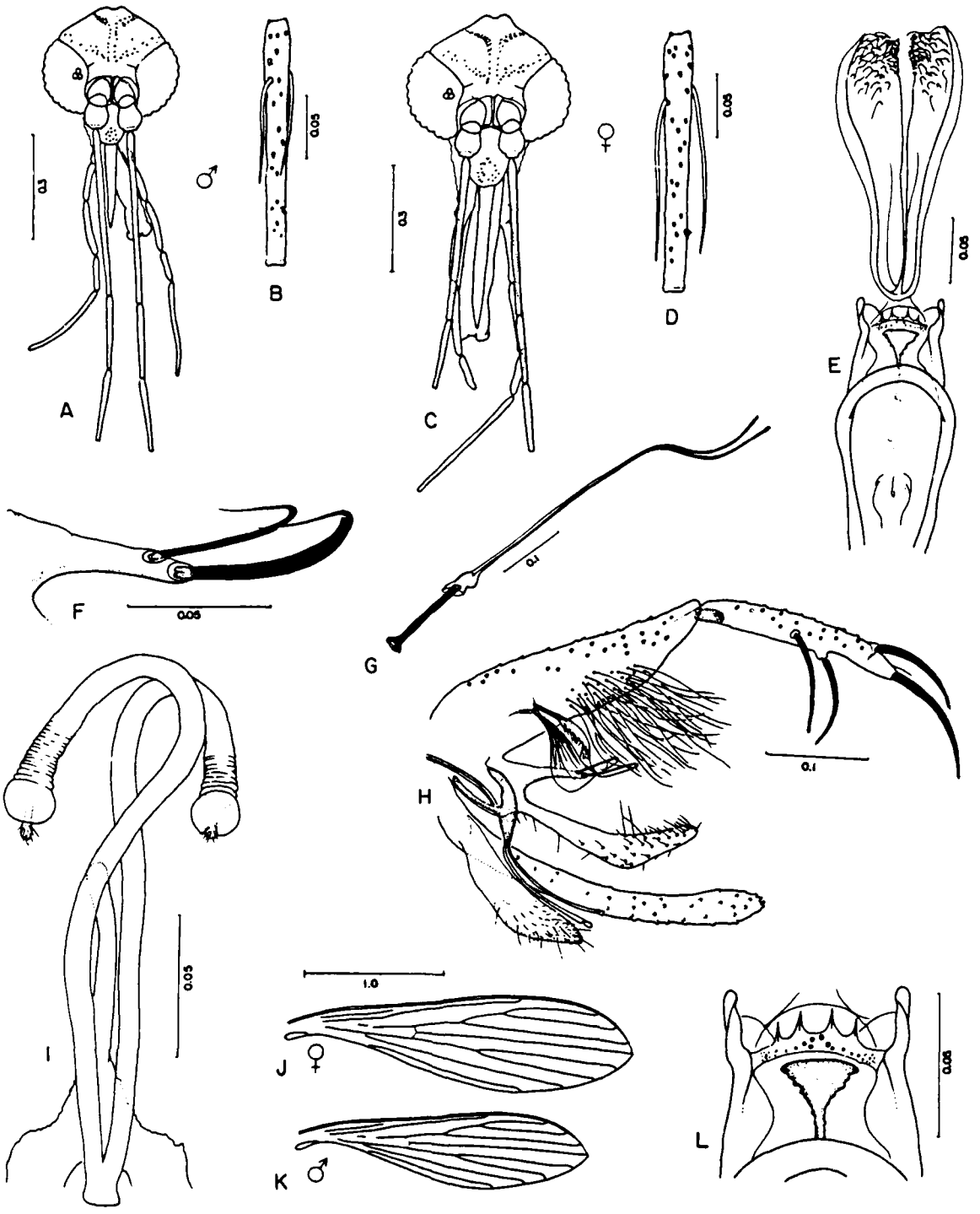



Plate 12-6

Lutzomyia bifoliata. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Dorsal arm of paramere; G. Genital pump & filaments; H. Male genitalia; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

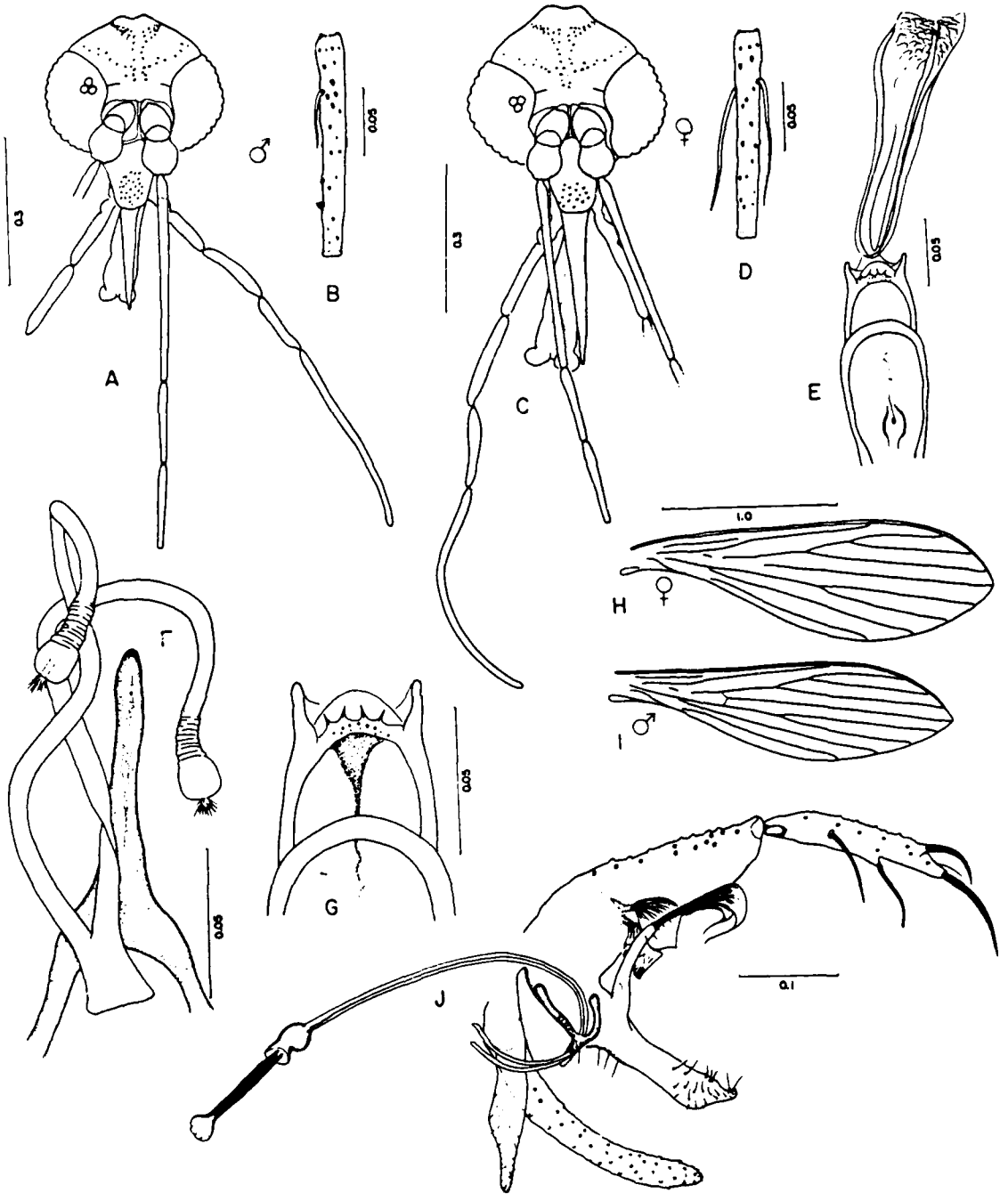



Plate 12-7

Lutzomyia lichyi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere; E. Female cibarium & pharynx; F. Spermathecae; G. Female cibarium; H. Female wing; I. Male wing; J. Male genitalia (from Young 1979).

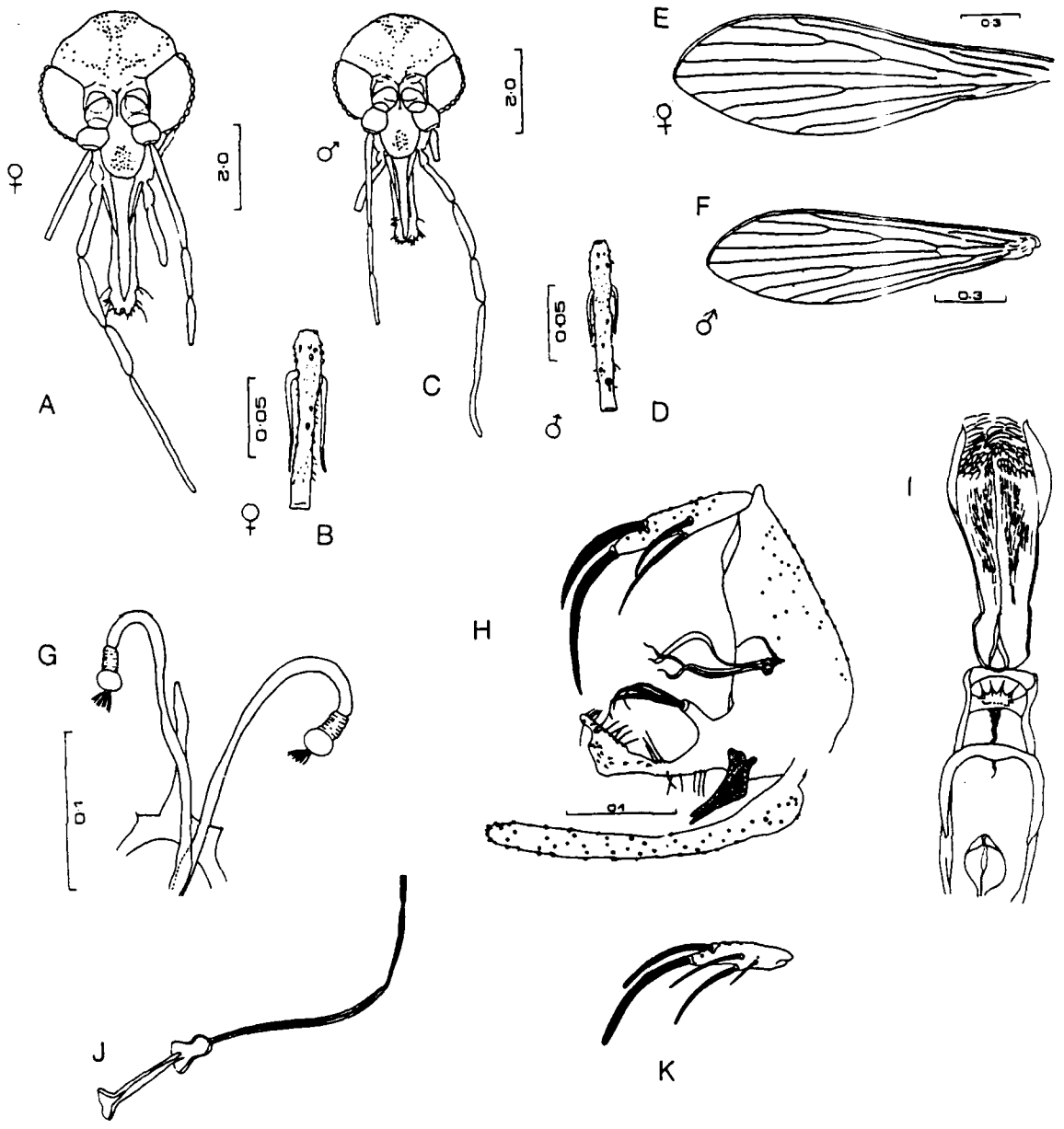



Plate 12-8

Lutzomyia dispar. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Spermathecae; H. Male terminalia; I. Female cibarium & pharynx; J. Genital pump & filaments; K. Style with extra spine, abnormal (from Williams & Carvalho 1979).

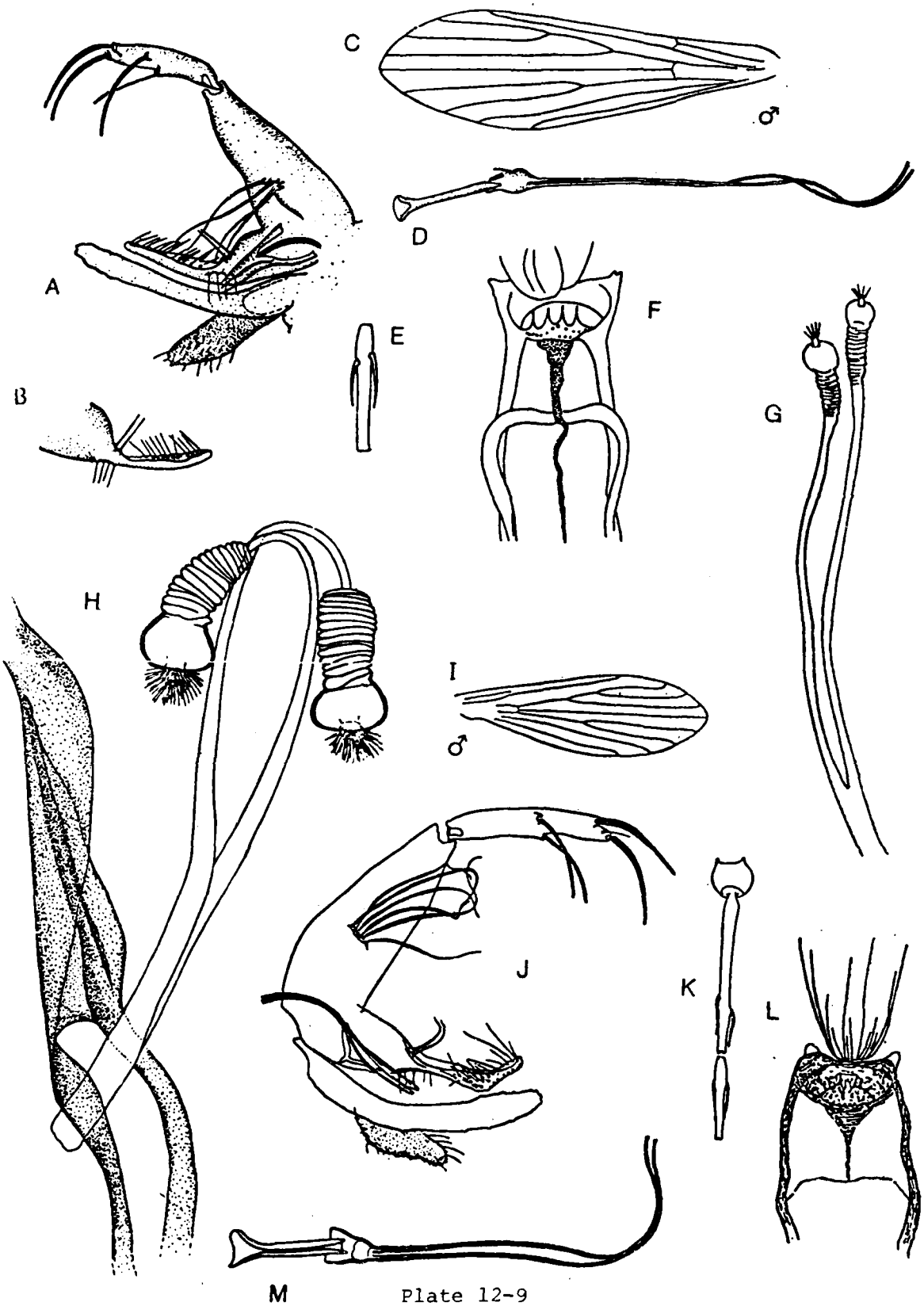



Plate 12-9

Lutzomyia ischnacantha. A. Male terminalia; B. Paramere; C. Male wing; D. Genital pump & filaments; E. Male flagellomere II; F. Female cibarium; G. Spermathecae (figs. A-E from Martins et al. 1962d; Figs. F-G from Martins et al. 1975c).

Lutzomyia amarali. H. Spermathecae; I. Male wing; J. Male terminalia; K. Male flagellomeres; L. Female cibarium; M. Genital pump & filaments (figs. I & L from Barretto & Coutinho 1940b; figs. K,K.&M from Martins et al. 1975c).

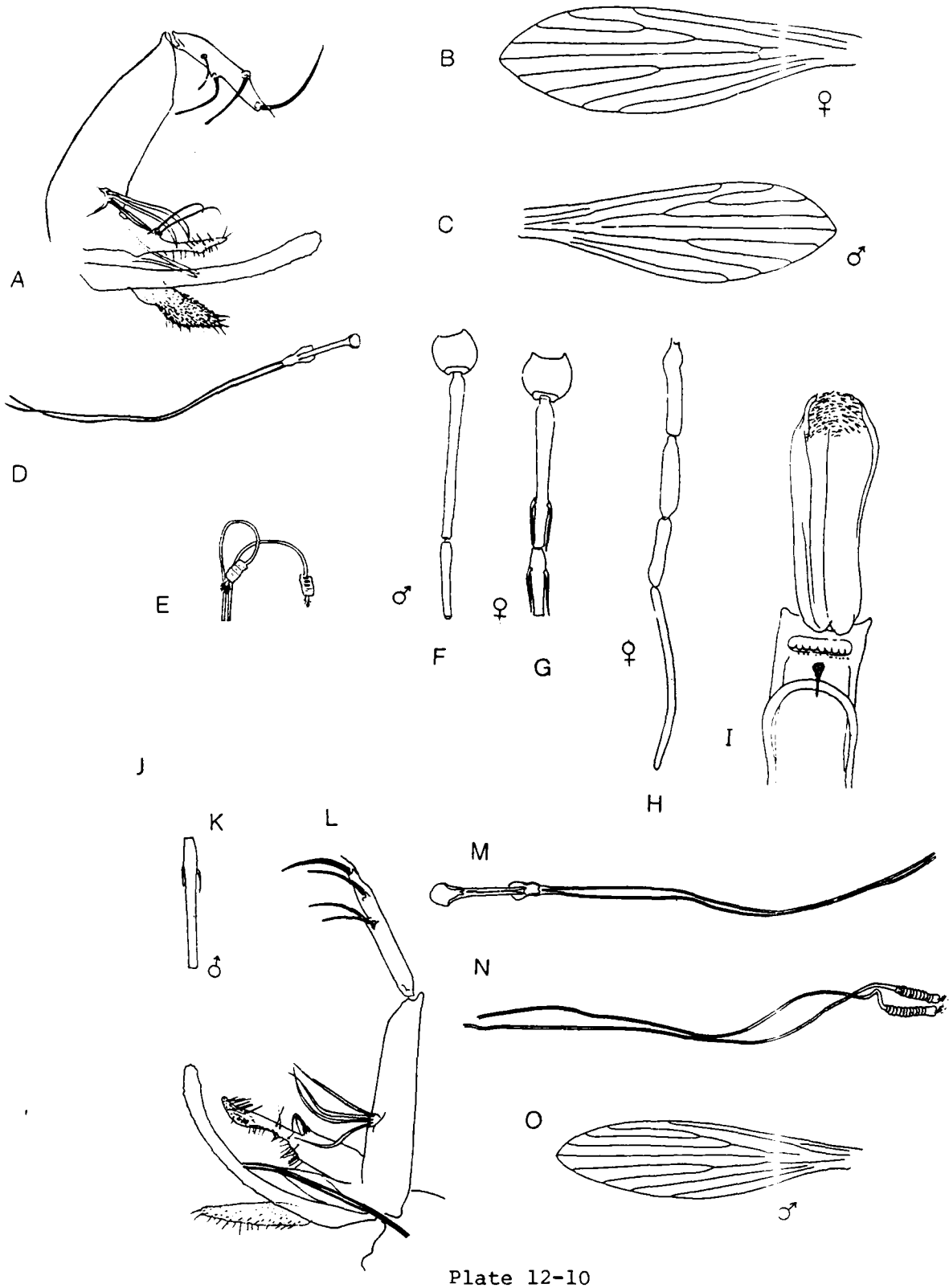



Plate 12-10

Lutzomyia cruzi. A. Male terminalia; B. Female wing; C. Male wing; D. Genital pump & filaments; E. Spermathecae; F. Male flagellomeres & pedicel; G. Female flagellomeres & pedicel, showing ascoids; H. Female palpus; I. Female cibarium & pharynx (from Martins et al. 1984).

Lutzomyia souzalopesi. K. Male flagellomere; L. Male terminalia; M. Genital pump & filaments; N. Spermathecae; O. Male wing (from Martins et al. 1970b).

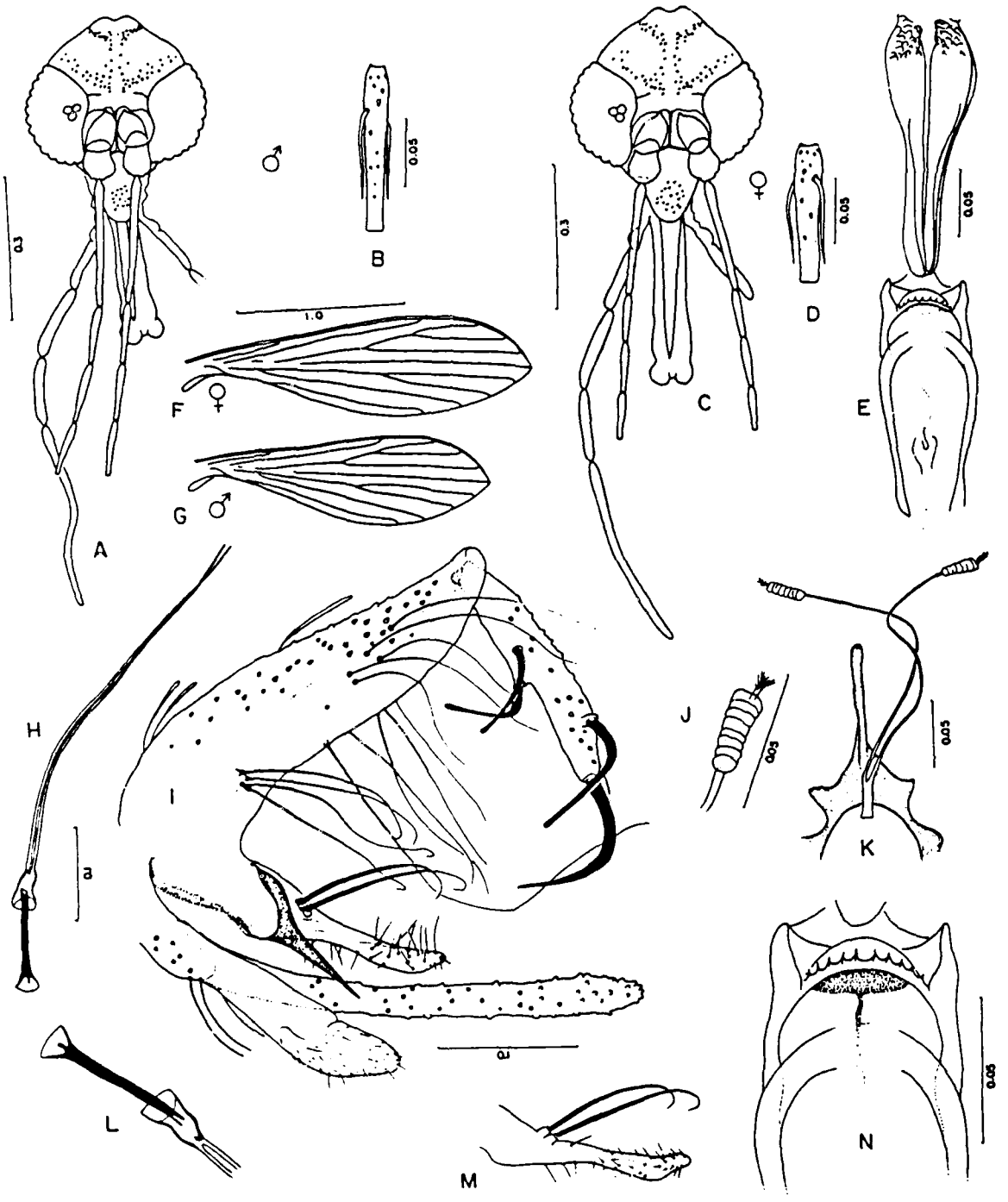



Plate 12-11

Lutzomyia longipalpis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Female wing; G. Male wing; H. Genital pump & filaments; I. Male genitalia; J. Body of spermathecae; K. Spermathecae; L. Genital pump, same scale as 15I; M. Paramere of male from Huila Dept., Colombia; N. Female cibarium (from Young 1979).




Plate 12-12

Lutzomyia gaminarai A. Male wing; B. Male terminalia; C. Genital pump & filaments; D. Pedicel & flagellomeres I & II; E. Male palpus; F. Paramere (from Martins et al. 1961c).

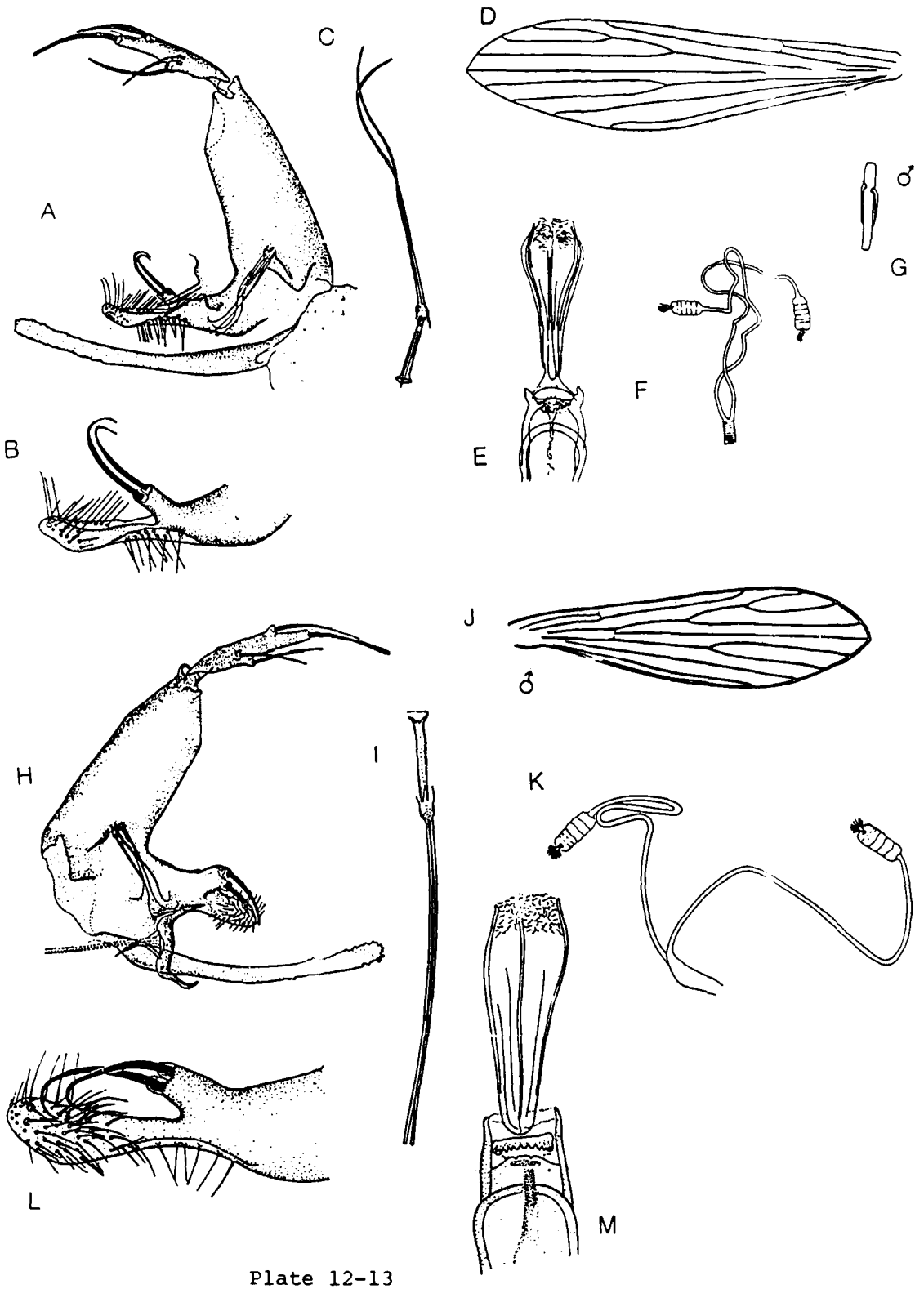



Plate 12-13

Lutzomyia alencari. A. Male terminalia; B. Paramere; C. Genital pump & filaments; D. Male wing; E. Female cibarium & pharynx; F. Spermathecae; G. Male flagellomere II (Martins et al. 1962e, female figs. from Martins et al. 1982

Lutzomyia ischyracantha. H. Male terminalia; I. Genital pump & filaments; J. Male wing; K. Spermathecae; L. Paramere; M. Female cibarium & pharynx (from Martins et al. 1962a).

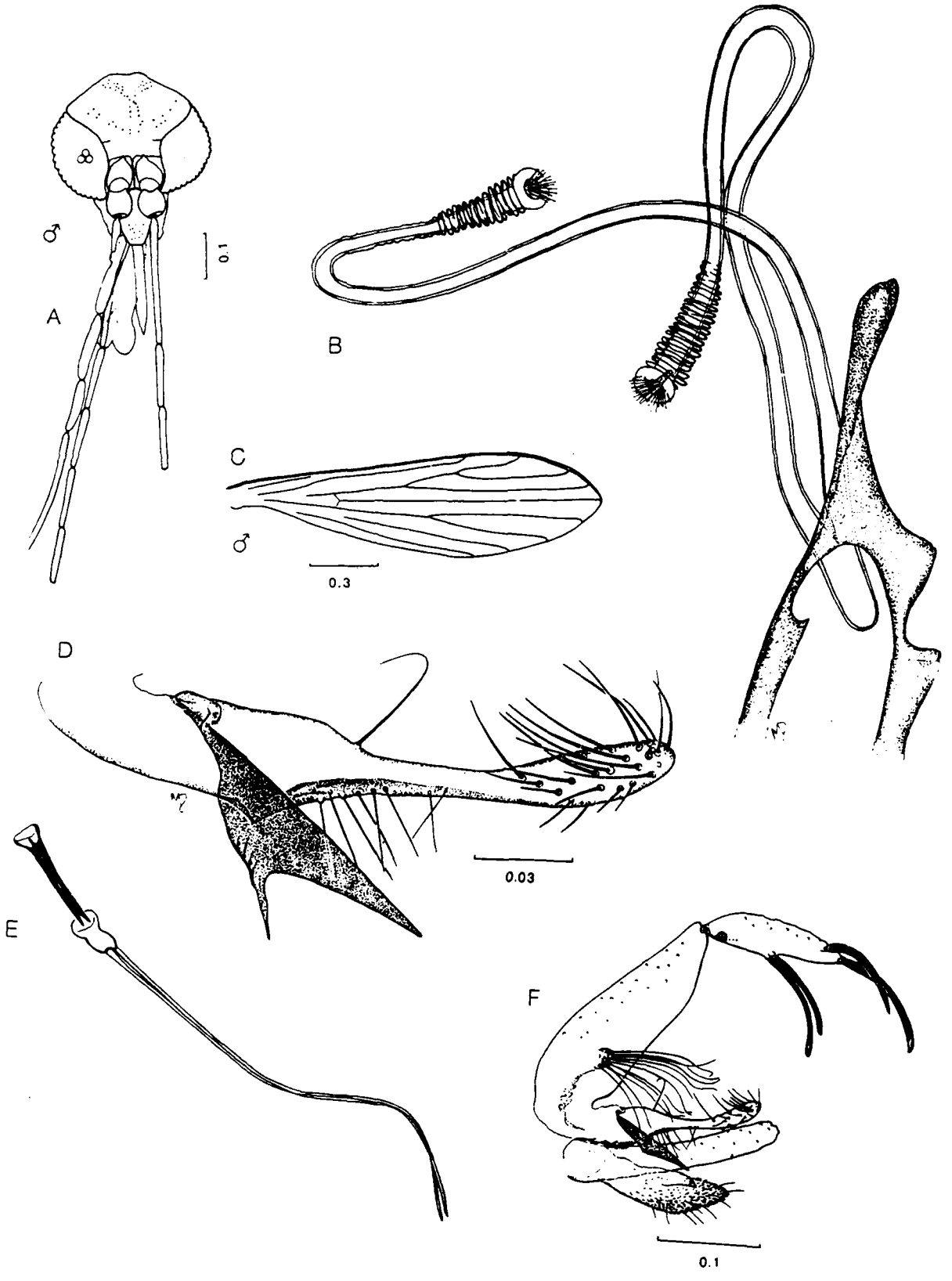



Plate 12-14

Lutzomyia (Lutzomyia) n.sp. #1. A. Male head; B. Spermathecae; C. Male head; D. Paramere; E. Genital pump & filaments; F. Male terminalia.

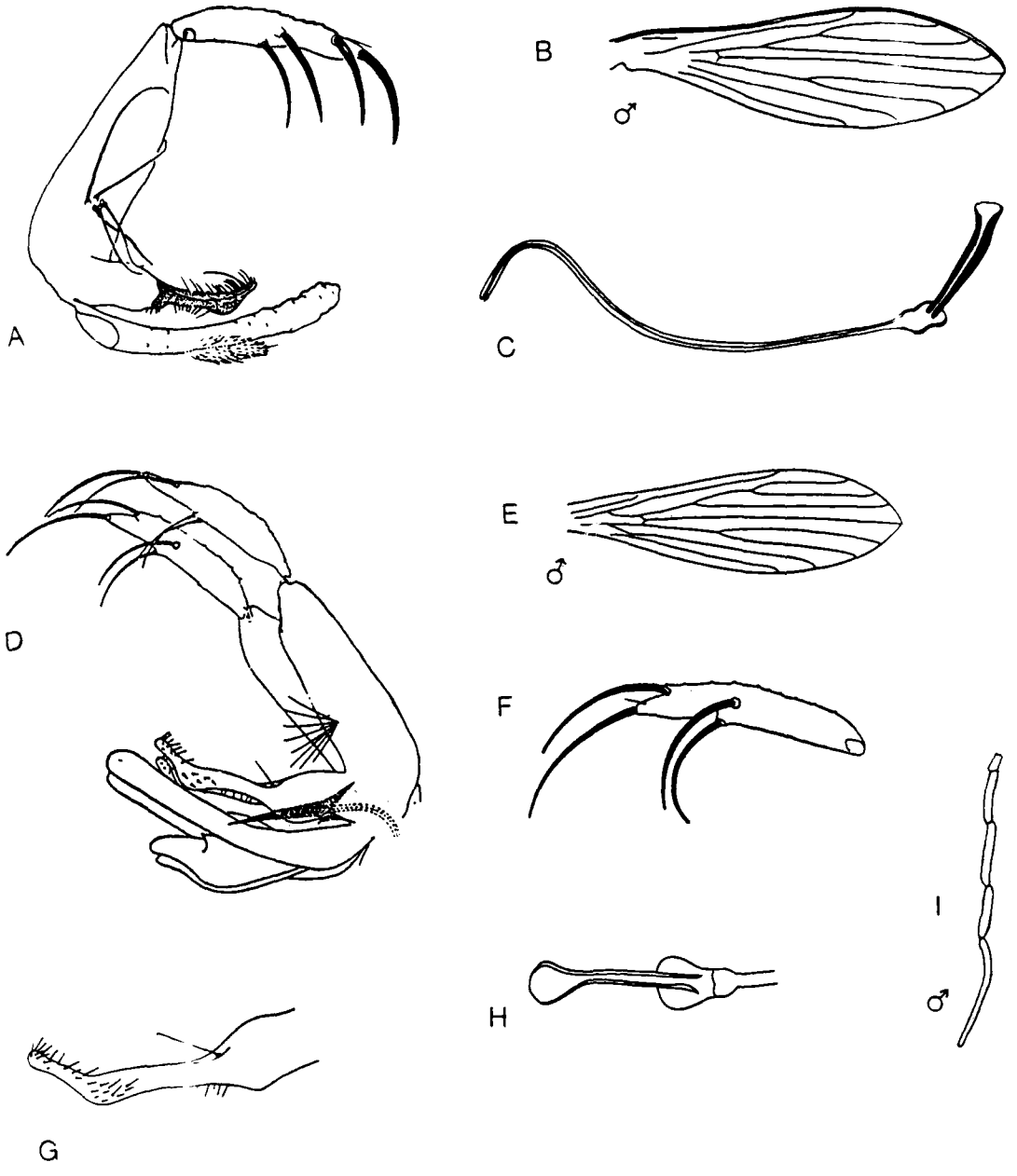



Plate 12-15

Lutzomyia caligata. A. Male terminalia; B. Male wing; C. Genital pump & filaments (from Martins et al. 1965).

Lutzomyia castroi. D. Male terminalia; E. Male wing; F. Style; G. Paramere; H. Genital pump; I. Male palpus (from Barretto & Coutinho 1941b).

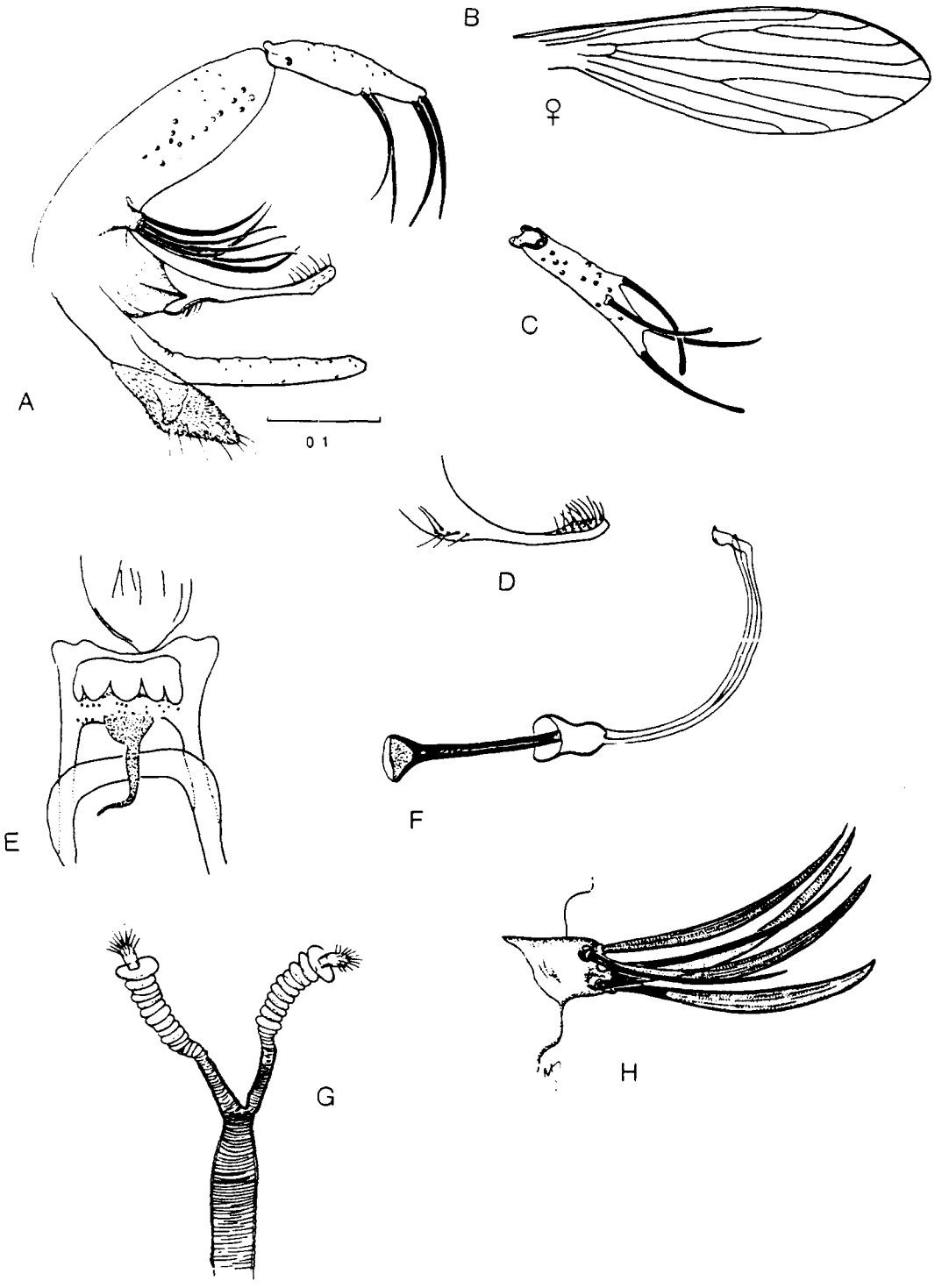



Plate 12-16

Lutzomyia cipoensis. A. Male terminalia; B. Female wing; C. Style; D. Paramere; E. Female cibarium; F. Genital pump & filaments; G. Spermathecae; H. Coxite tuft (female figs. from Martins et al. 1975c).

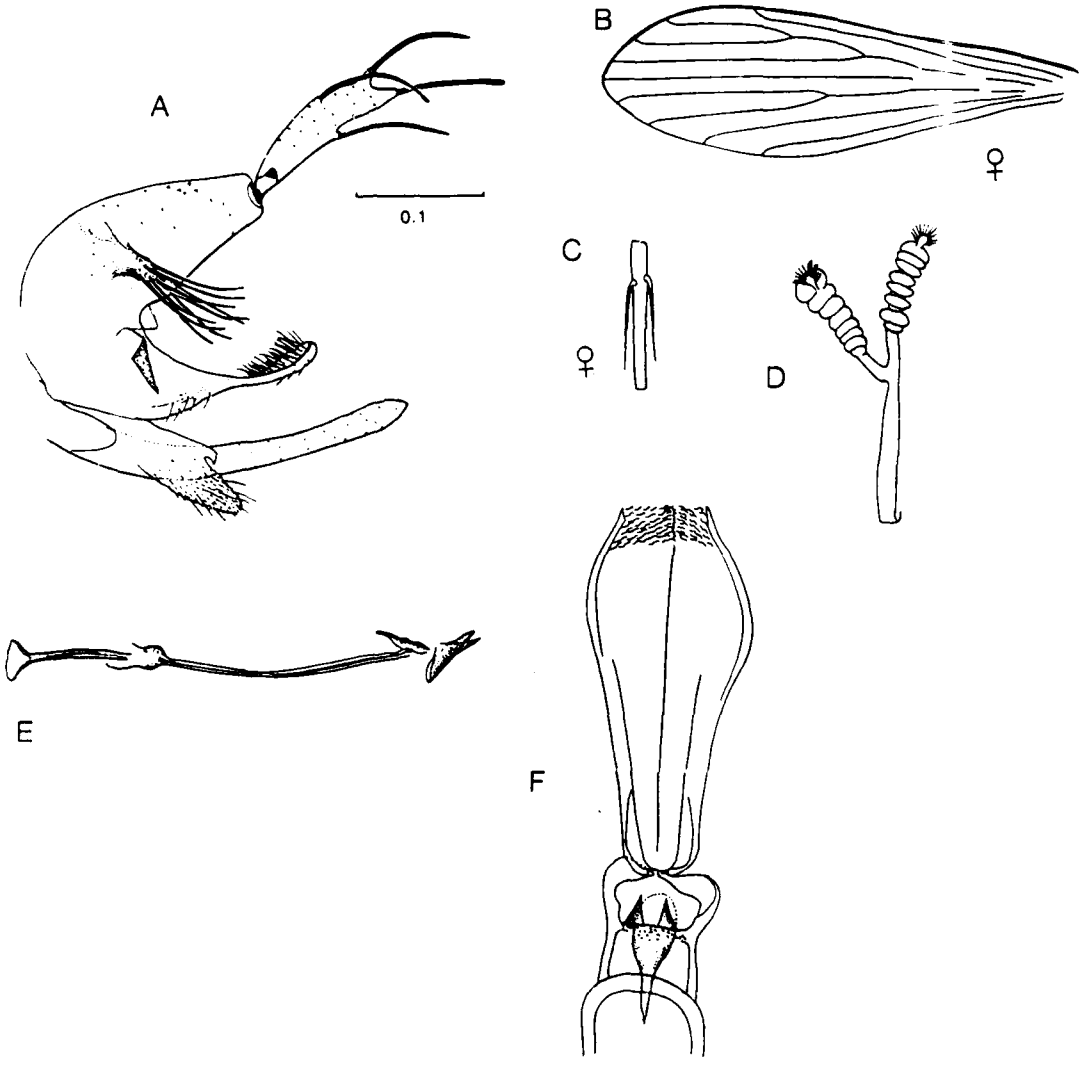



Plate 12-17

Lutzomyia gasparviannai. A. Male terminalia; B. Female wing; C. Female flagellomere II; D. Spermathecae; E. Genital pump & filaments; F. Female cibarium & pharynx (from Martins et al. 1962a).

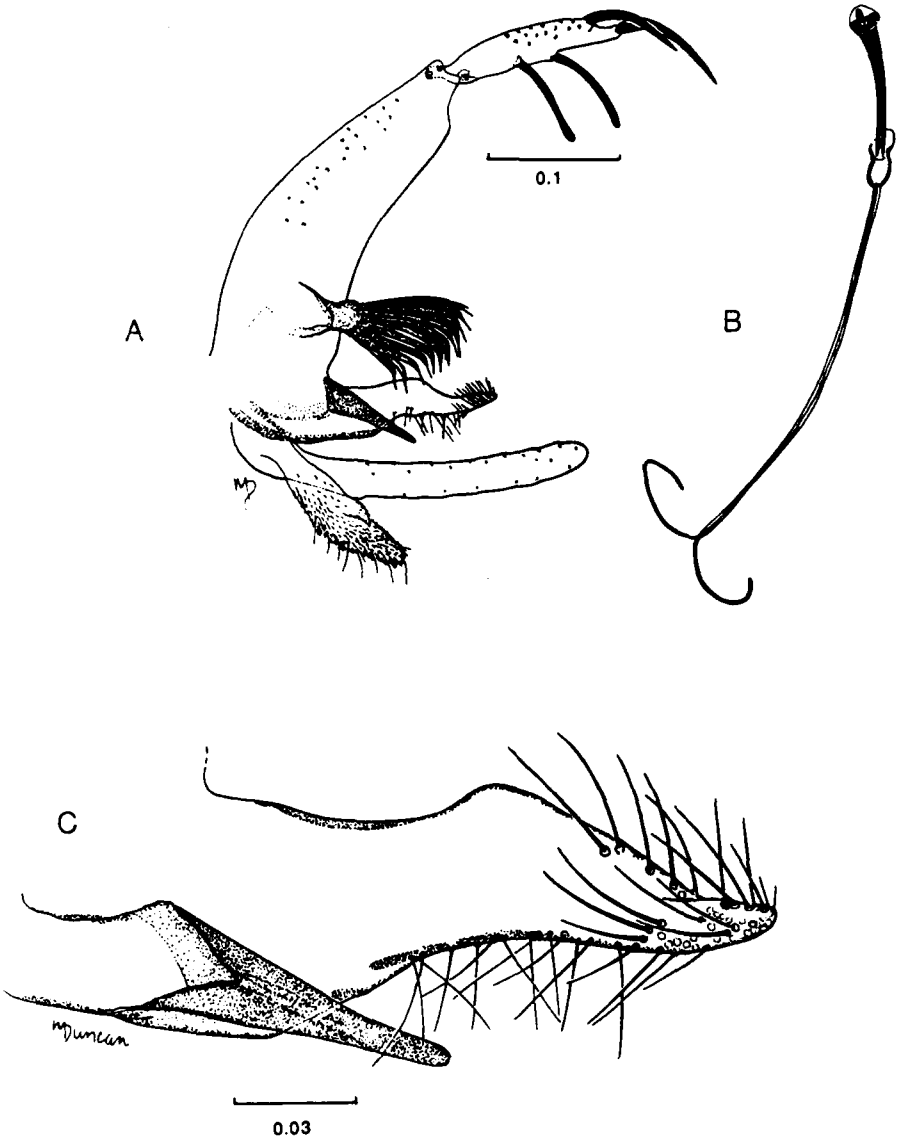



Plate 12-18

Lutzomyia flabellata. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

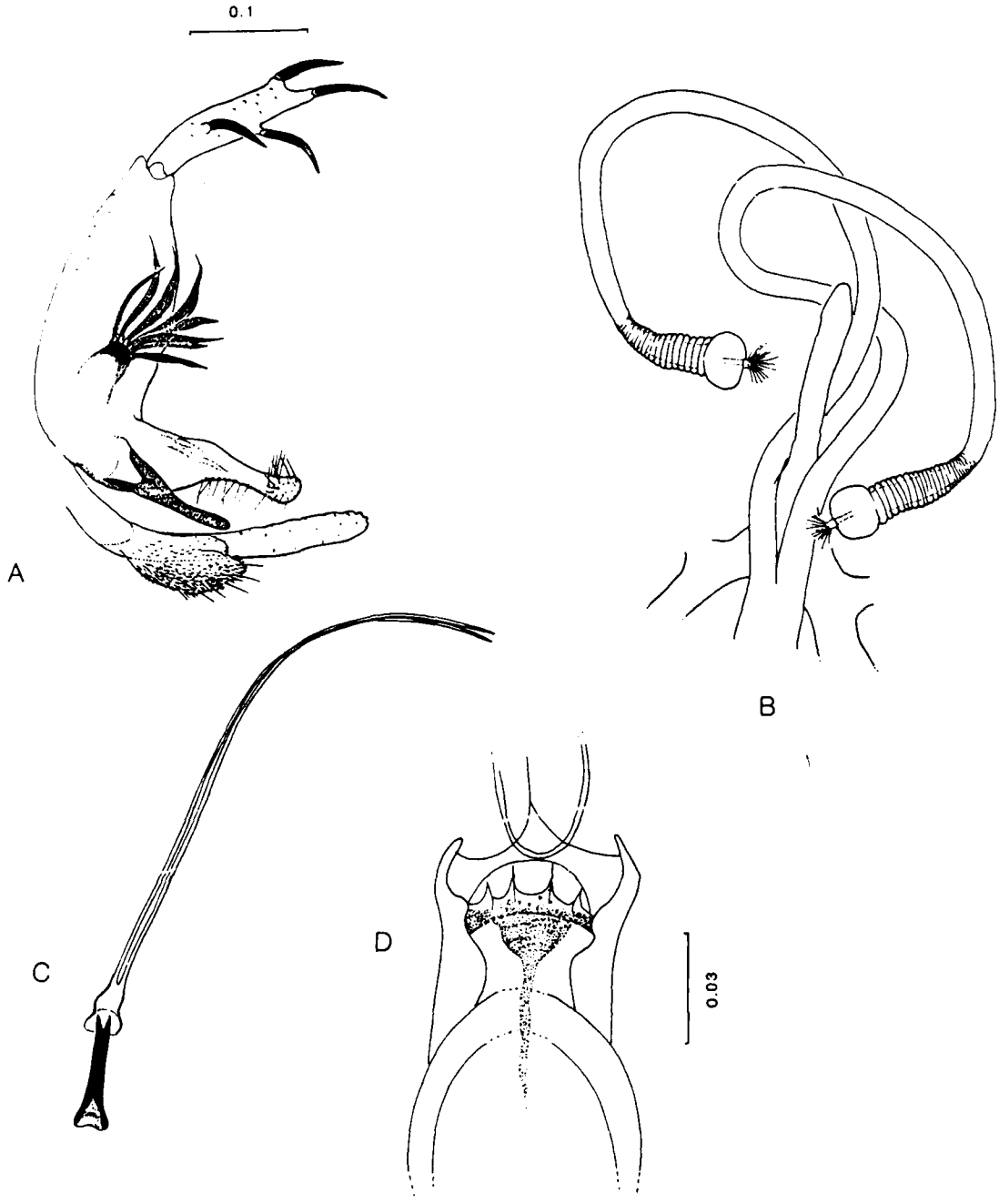



Plate 12-19

Lutzomyia spathotrichia. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Female cibarium.

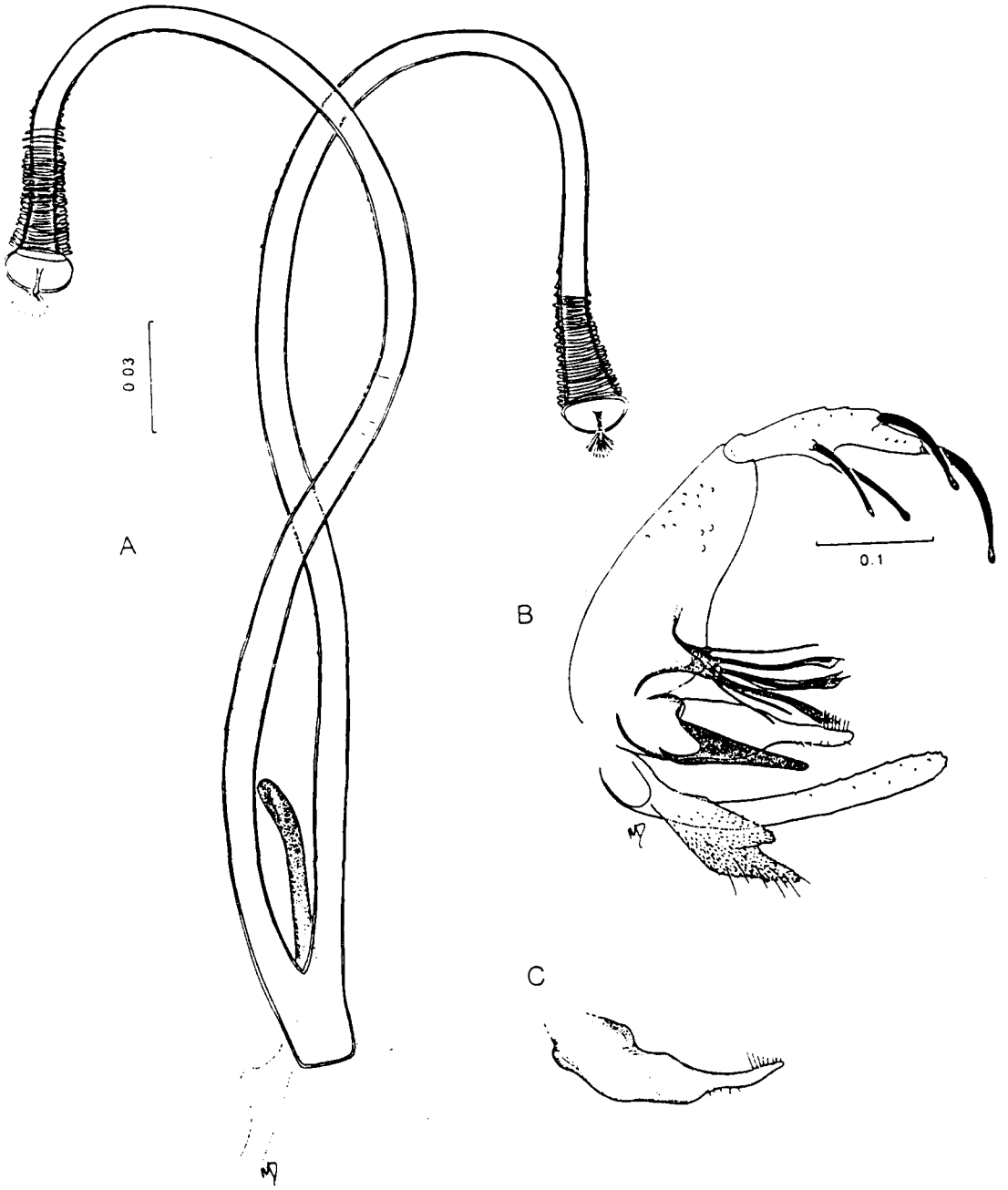



Plate 12-20

Lutzomyia carvalhoi. A. Spermathecae; B. Male terminalia; C. Paramere.

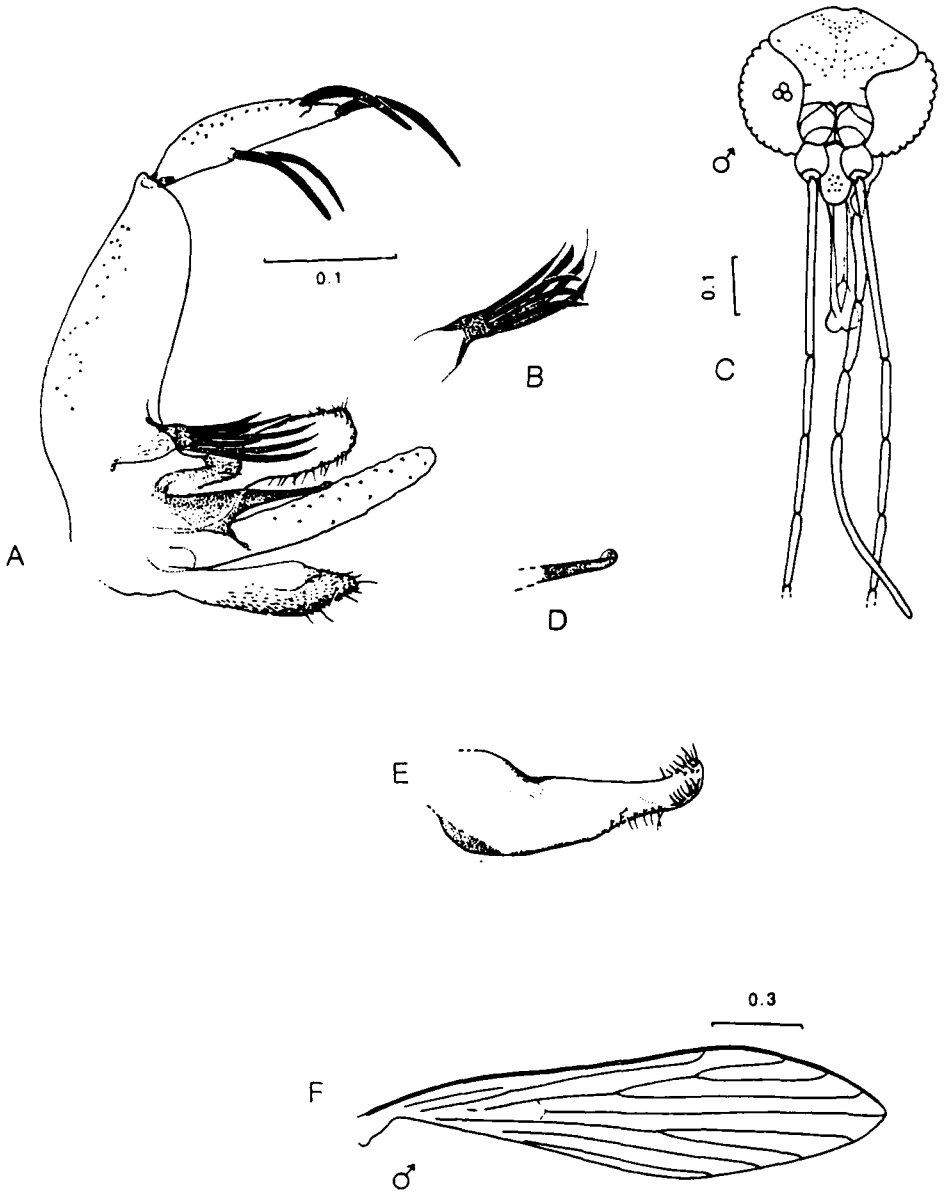



Plate 12-21

Lutzomyia ararcuarensis. A. Male terminalia; B. Coxite tuft; C. Male head; D. Aedeagus tip; E. Paramere, different view; F. Male wing.

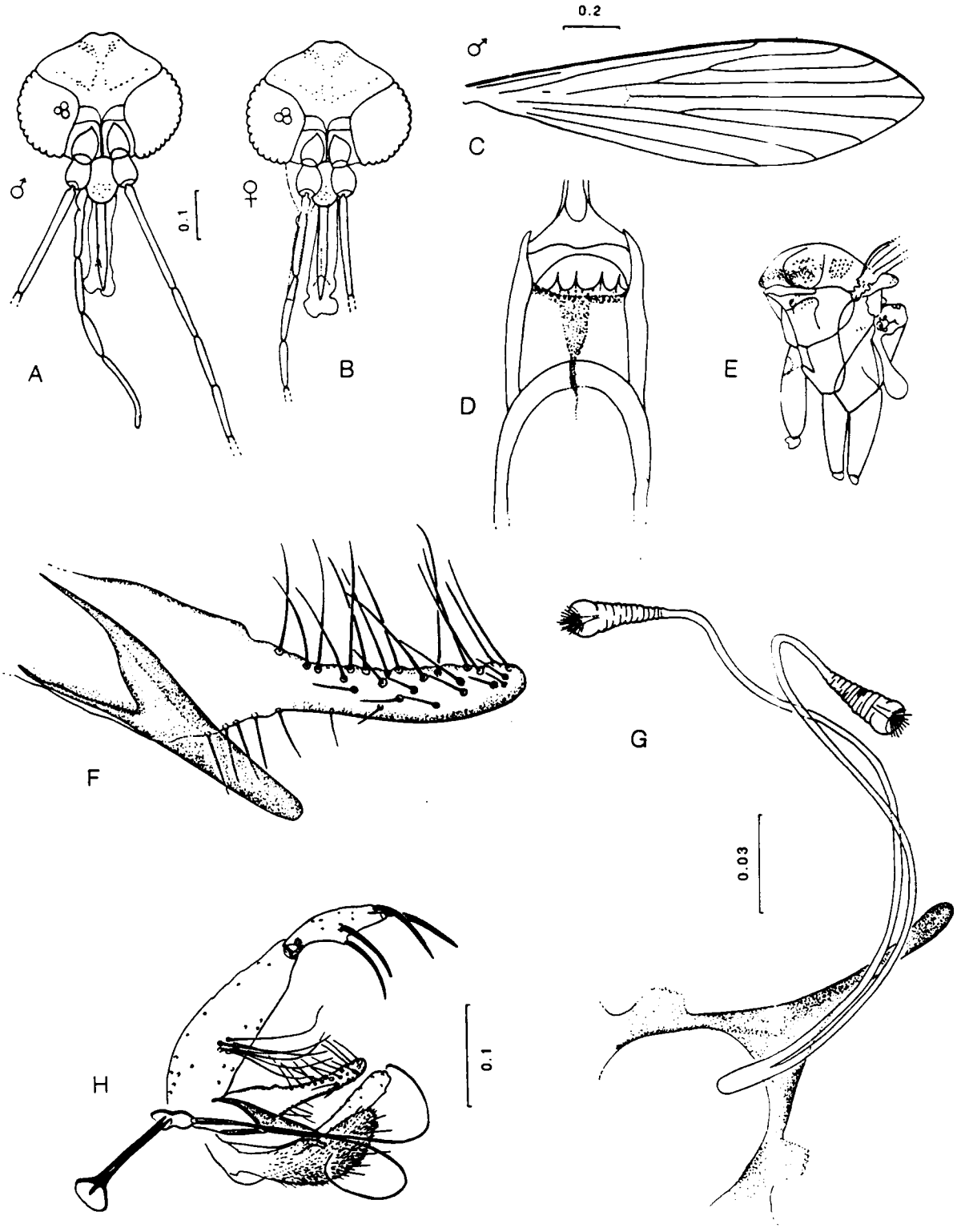



Plate 12-22

Lutzomyia evangelistai. A. Male head; B. Female head; C. Male wing; D. Female cibarium; E. Thorax; F. Paramere; G. Spermathecae; H. Male terminalia.

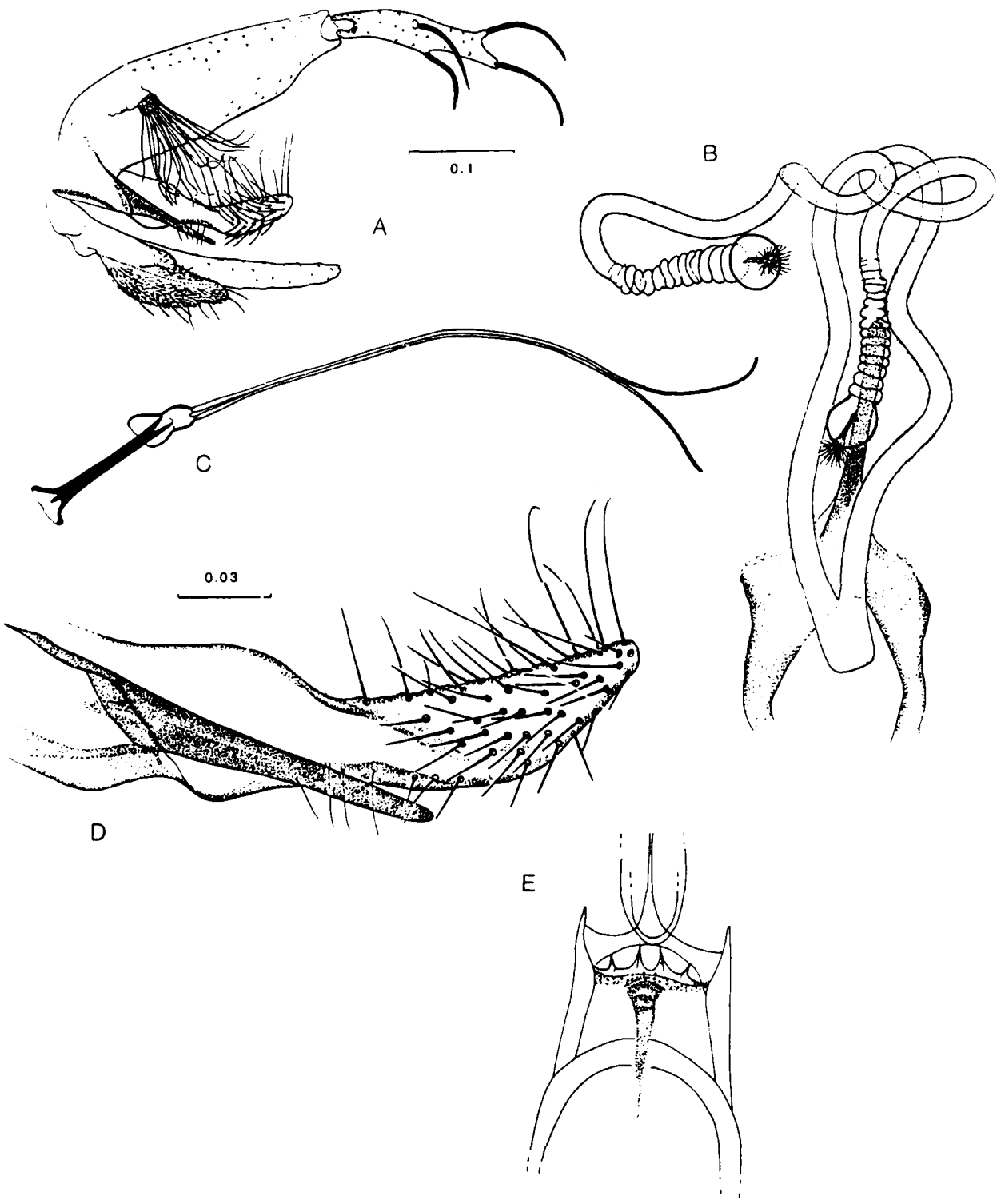



Plate 12-23

Lutzomyia sherlocki. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Paramere; E. Female cibarium.

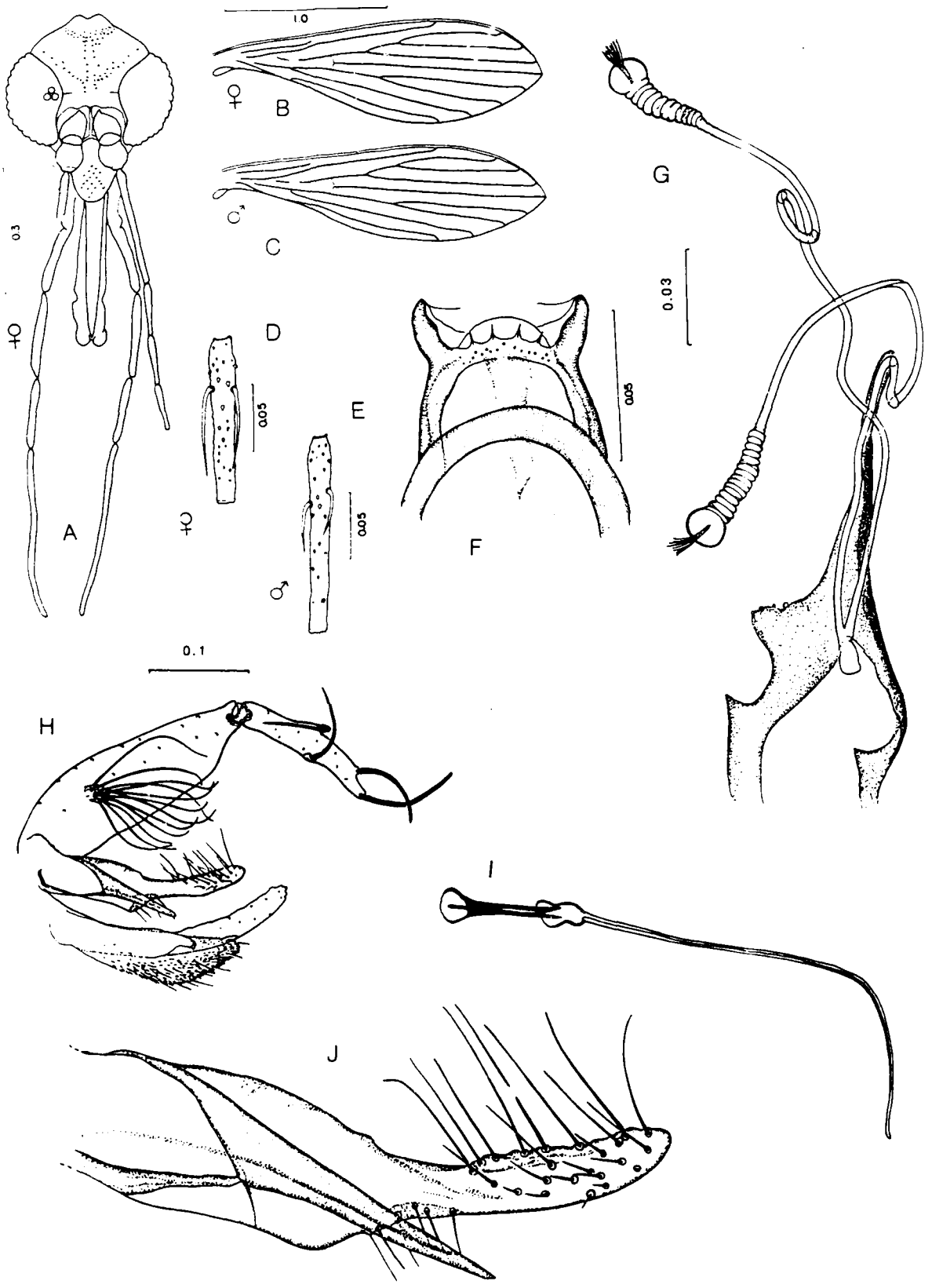



Plate 12-24

Lutzomyia gomezi. A. Female head; B. Female wing; C. Male wing; D. Female flagellomere II; E. Male flagellomere II; F. Female cibarium; G. Spermathecae; H. Male terminalia; I. Genital pump & filaments; J. Paramere (figs. A-F from Young 1979).

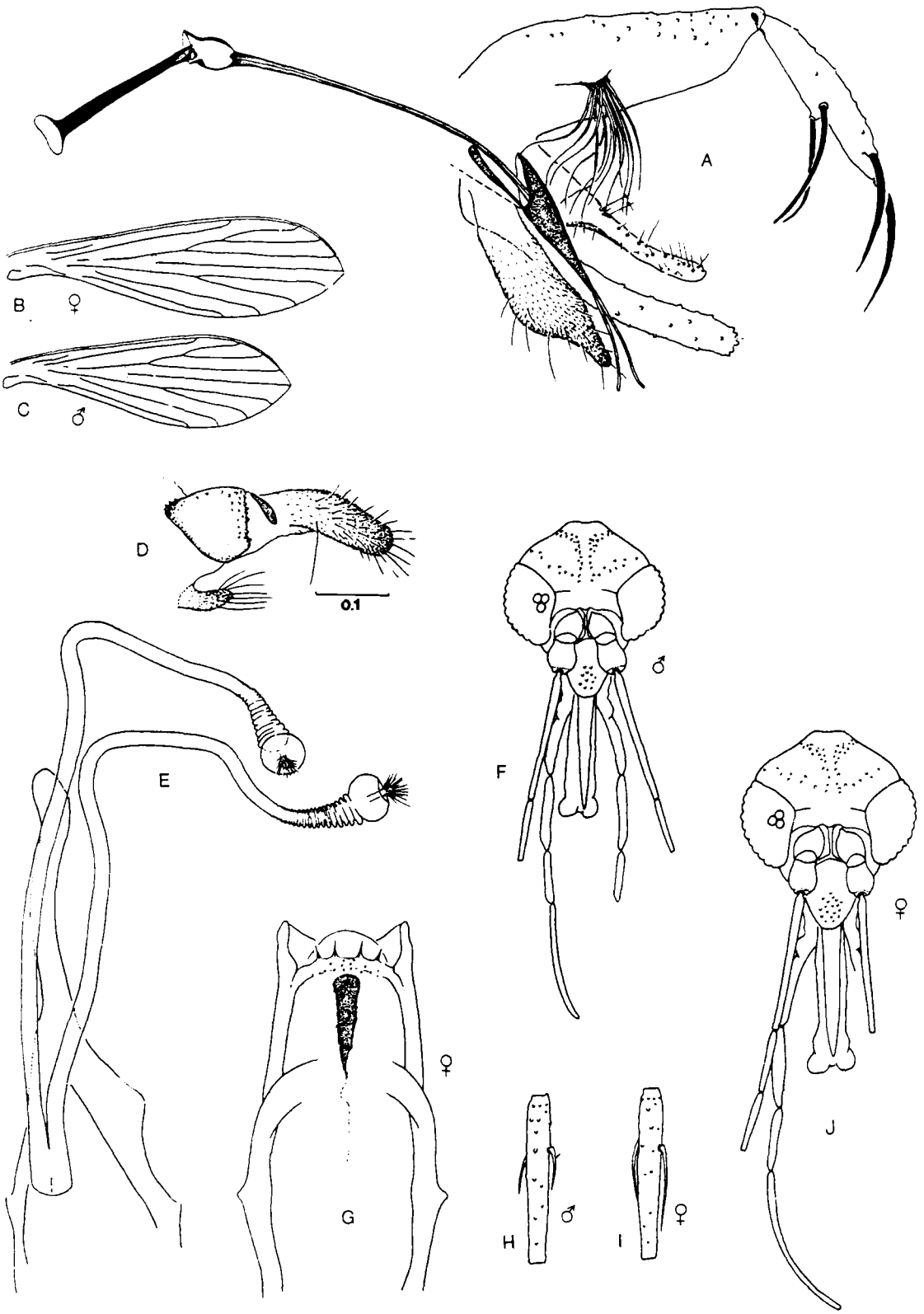



Plate 12-25

Lutzomyia cruciata. A. Male terminalia; B. Female wing; C. Male wing; D. End of female abdomen; E. Spermathecae; F. Male head; G. Female cibarium; H. Male flagellomere II; I. Female flagellomere II; J. Female head (from Young & Perkins 1984).

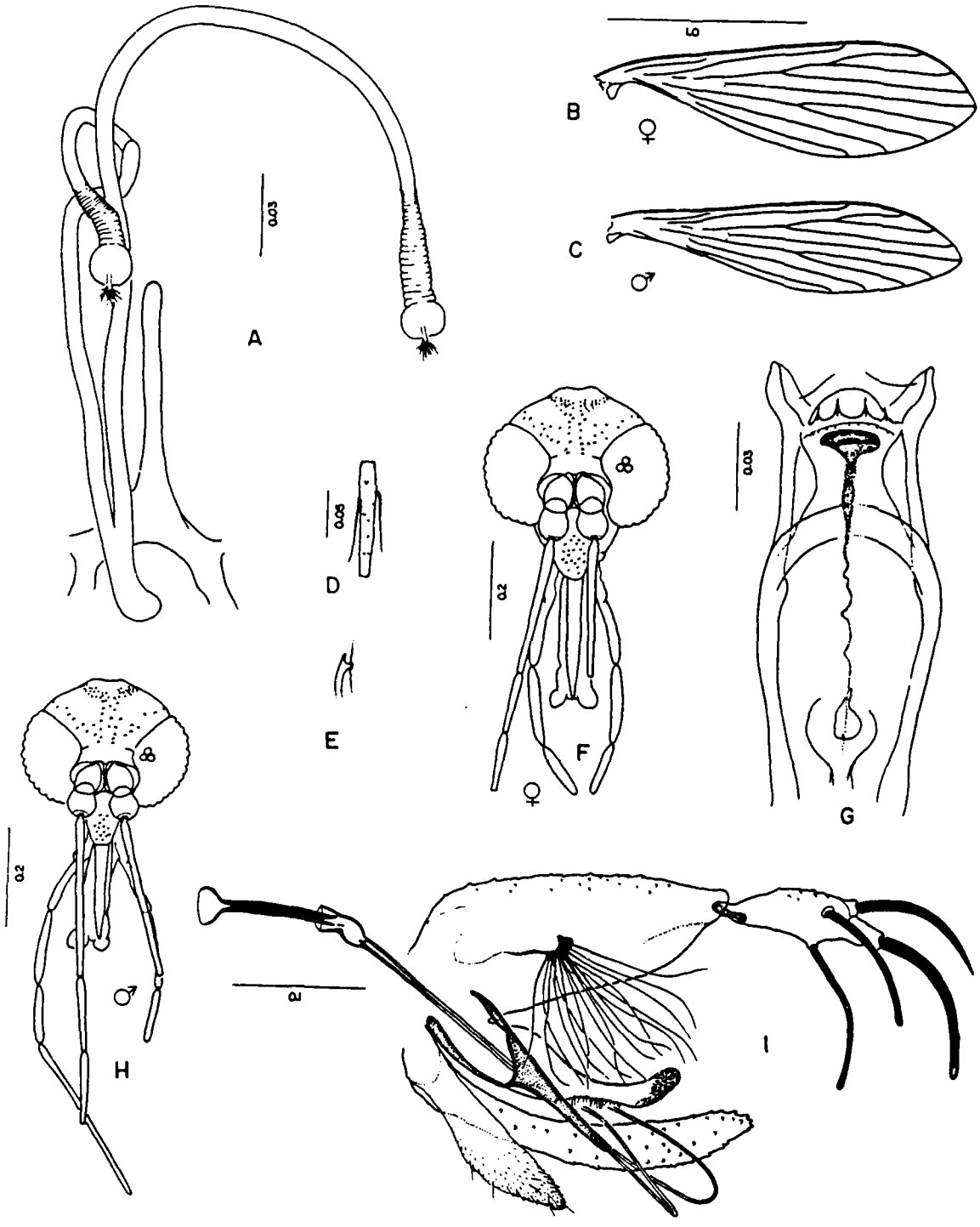



Plate 12-26

Lutzomyia marinkellei. A. Spermathecae; B. Female wing; C. Male wing; D. Female flagellomere II; E. Base of ascoid; F. Female head; G. Female cibarium; H. Male head; I. Male genitalia (from Young 1979).

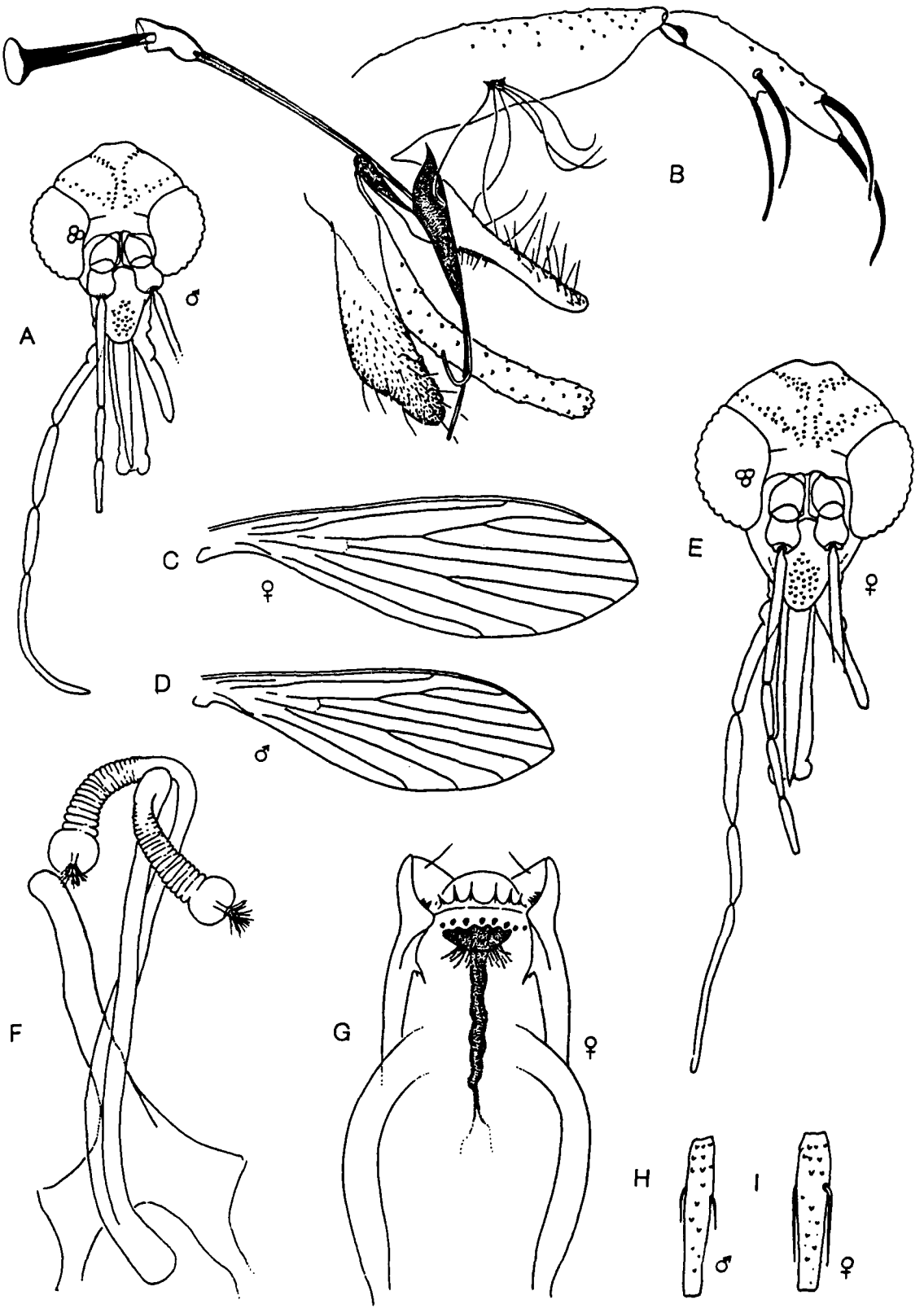
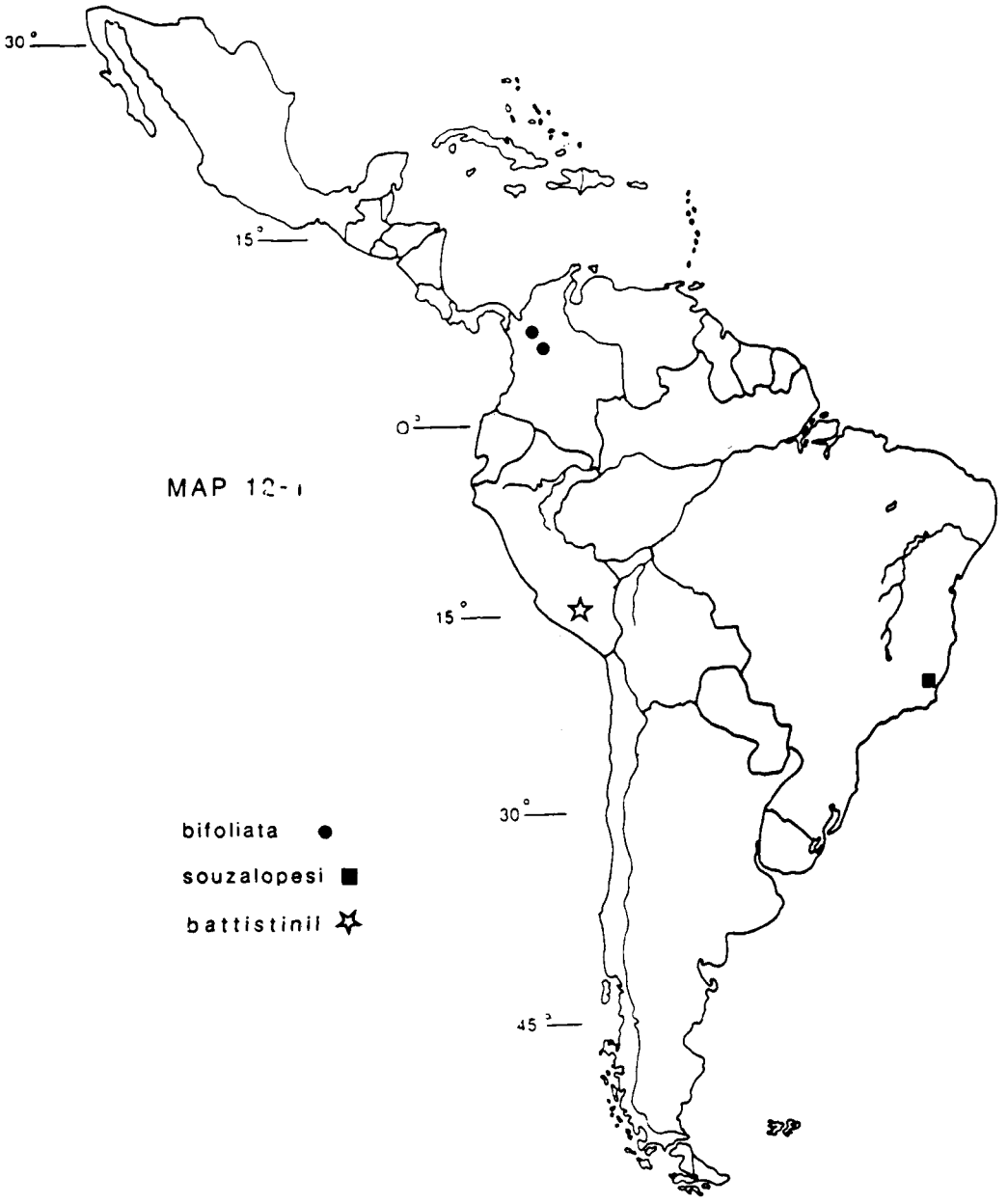
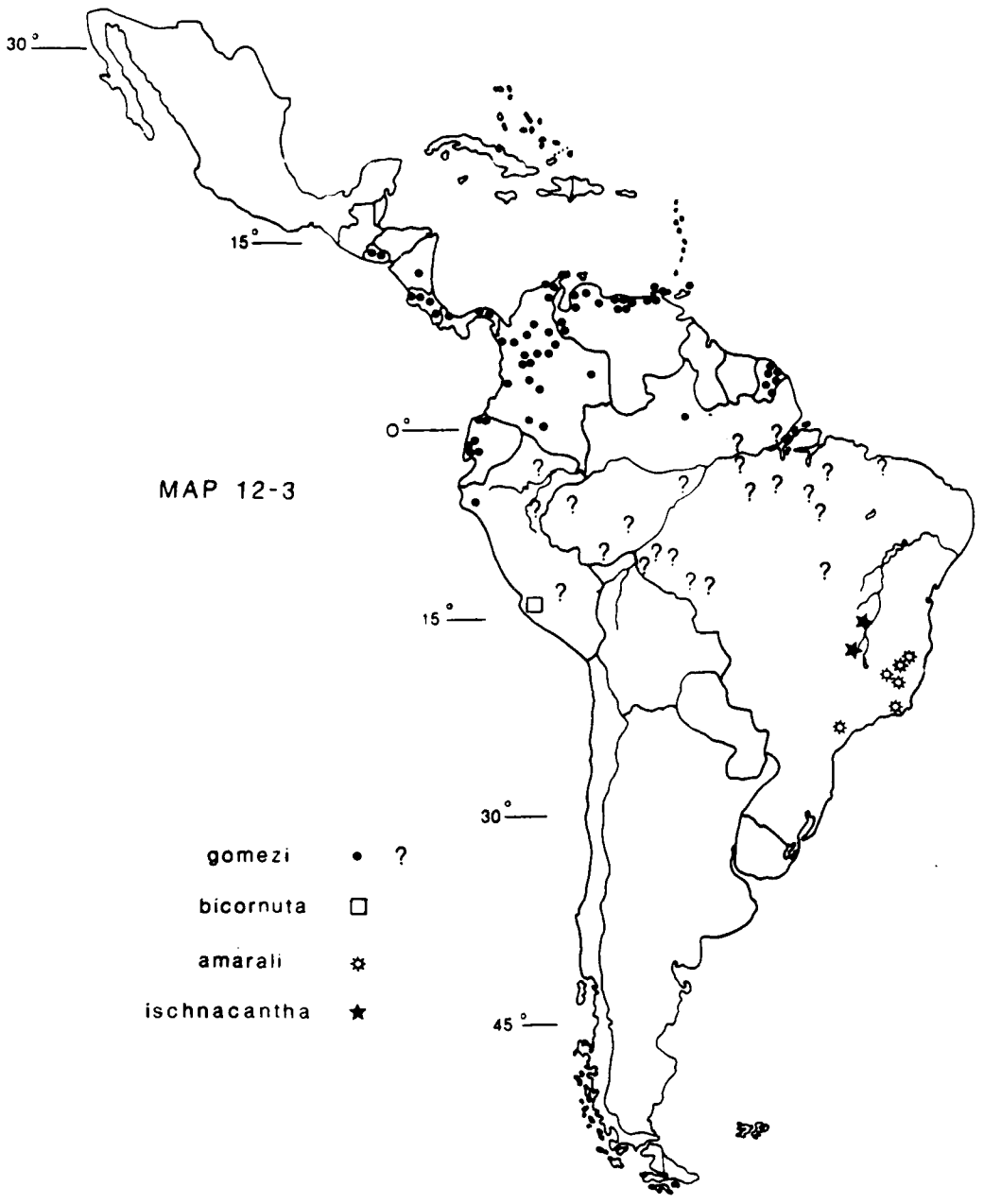



Plate 12-27

Lutzomyia diabolica. A. Male head; B. Male terminalia; C. Female wing; D. Male wing; E. Female head; F. Spermathecae; G. Female cibarium; H. Male flagellomere II; I. Female flagellomere II (from Young & Perkins 1984).




MAP 12-1


30°
15°
0°
15°
30°
45°
MAP 12-3
gomezi
bicornuta
amarali
ischnacantha




MAP 12-5

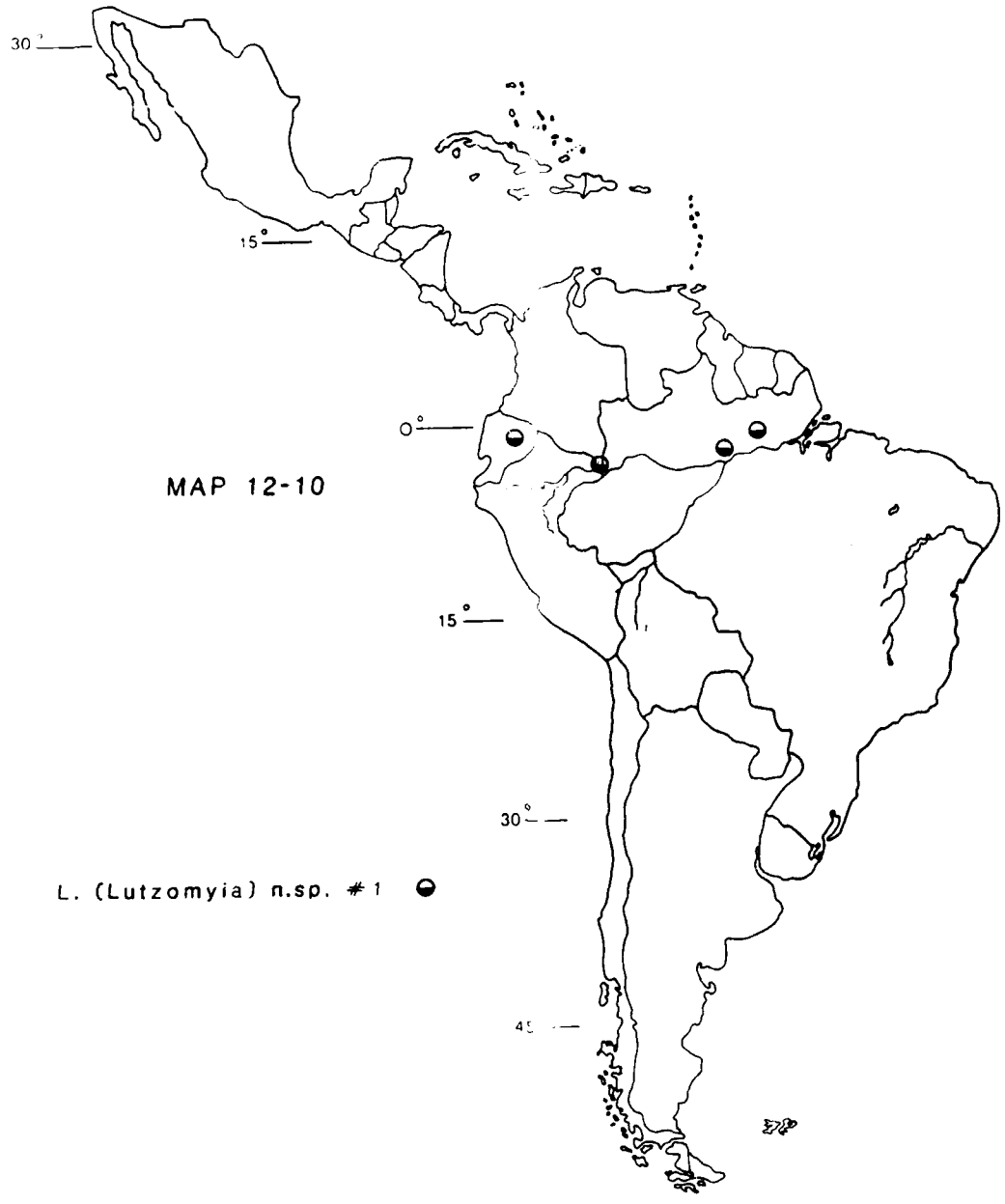


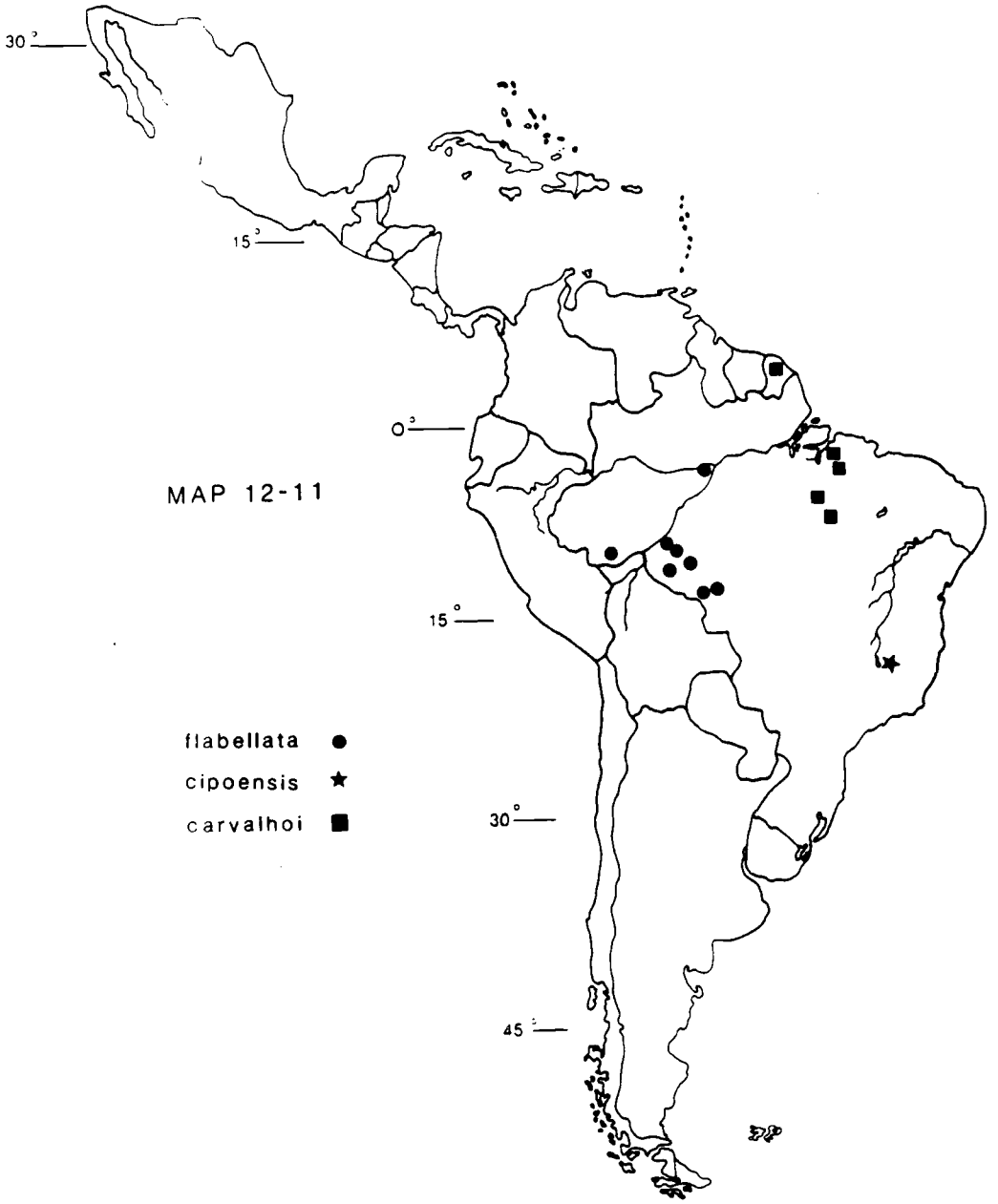

MAP 12-7




MAP 12-9

longipalpis


30°
15°
0°
15°
30°
MAP 12-10
L. (Lutzomyia) n.sp. #1


30°
15°
0°
15°
30°
45°
MAP 12-11
flabellata
cipoensis
carvalhoi


30°
15°
0°
15°
30°
45°
MAP 12-12
gasparviannai
araracuarensis

## 13. Lutzomyia Subgenus Sciopemyia Barretto

Lutzomyia subgenus Sciopemyia Barretto 1962: 96 (type species: P. nordestinus Mang. by orig. designation).

Lutzomyia species group microps Young & Arias 1984: 425.

Identification. Coloration pale to light brown. Antennal flagellomeres relatively long with simple ascoids. Palpomere 5 shorter than or subequal to palps. 3 + 4. ♀ cibarium with 4 horizontal teeth with inner pair separated by a relatively wide gap; vertical teeth nonexistent or few; arch conspicuous only at sides; pigment patch inconspicuous. Pharynx unarmed. Spermathecae tubular with complete or incomplete annuli; common duct much shorter than individual ducts. ♂ genitalia. Coxite with or without persistent setae. Style with 4 spines & no subterminal seta. Paramere simple or with short dorsal protuberance or modified setae.

Barretto's original definition and species composition of this subgenus (1962) differ greatly from our present treatment. Lutzomyia sordellii (= P. nordestina), the type species of Sciopemyia, is the only species retained by us in this group. Its inclusion seems justified on the basis of several character states of both sexes. Forattini (1973) places some of these species in Lutzomyia, others in the genus Psychodopygus.

Medical Importance. Unknown; L. fluviatilis and L. microps have been collected infrequently on human bait.

Key to the Males of the subgenus Sciopemyia*

1. Coxite with 2 or persistent setae inserted on inner surface. ..... 2

   Coxite without persistent setae. ..... L. sordellii (Pl. 13-1)

2. Coxite with 6 or more persistent setae at inner base. ..... 3

   Coxite with 2-5 persistent setae at inner base.

   ..... L. fluviatilis (Pl. 13-2)

3. Genital filaments at least 6X length of genital pump. ..... 4

   Genital filaments 5X length of genital pump or shorter. ..... 6

4. Paramere with either a dorsal setiferous projection or relatively thick curved setae near middle of structure. ..... 5

   Paramere simple, without a dorsal projection or modified setae.

   ..... L. preclara (Pl. 13-3)

5. Coxite with 6-8 long persistent setae. Paramere with short dorsal projection bearing apical setae. ..... L. pennyi (Pl. 13-4)

   Coxite with group of 12-14 shorter setae. Paramere without dorsal projection but with 3-4 curved setae near middle of structure.

   ..... L. nematoducta (Pl. 13-5)

6. Paramere relatively broad, its shape as figured. .....

   ..... L. servulolimai (Pl. 13-6)

   Paramere more slender with different shape. ..... L. microps (Pl. 13-6)

*Adapted from Young & Arias (1984).

Key to the Females of the Subgenus Sciopemyia*

1. Individual sperm ducts subequal in width throughout. ..... 2

   Individual sperm ducts tapered, e.g., much wider near junction of common duct than near junction of spermathecae. .....

   ..... L. nematoducta (Pl. 13-5)

2. Spermathecae & individual sperm ducts subequal in width. ..... 3

   Spermathecae clearly wider than individual ducts. .....

   ..... L. sordellii (Pl. 13-1)

3. Individual sperm ducts longer than 5X length of spermathecae.

   ..... L. microps (Pl. 13-6)

   L. fluviatilis (Pl. 13-2)

   Individual sperm ducts shorter than 4.5X length of spermathecae.

   ..... L. preclara (Pl. 13-3)

Lutzomyia (Sciopemyia) sordellii (Shannon & Del Ponte)

Plate 13-1

Phlebotomus sordellii Shannon & Del Ponte 1927: 730 (♂, Resistencia, Chaco, Argentina).

Flebotomus nordestinus Mangabeira 1942f: 327 (♂, Nova Olinda, Ceara, Brazil). Young & Morales 1987: 662 (as synonym of sordellii).

---

*The females of L. servulolimai and L. pennyi are unknown.

Phlebotomus longicornutus Floch & Abonnenc 1943a: 6 (♂, ♀, Montabo, Cayenne, French Guiana). Barretto 1946b: 534 (as synonym of nordestina). Forattini 1960a: 478 (Amapá, Brazil).

Lutzomyia nordestina: Barretto 1962: 96 (listed). Llanos 1973: 32 (figs., Peru). Martins et al. 1978: 165 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Young 1979: 233 (figs., refs., dist.). Fraiha et al. 1980a: 21 (Peru). Morales & Minter 1981: 97 (Colombia). Biancardi et al. 1982; 168 (Rondonia, Brazil). Arias & Freitas 1982: 404 (Acre, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 125 (figs., Costa Rica). Young et al 1985: 145 (Peru). Arias et al. 1985: 110 (negative for flagellates, Brazil). Ryan 1986: 120 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (natural trypanosome infections, Pará, Brazil).

Lutzomyia sordellii: Theodor 1965: 187 (listed). Young & Morales 1987: 662 (figs. of lectotype).

Psychodopygus nordestinus: Forattini 1973: 475 (♂, ♀ figs., tax.).

Distribution (Map 13-1). Costa Rica (Murillo & Zeledon 1985). Panama (Martins et al. 1978); Colombia (Young 1979; Morales & Minter 1981); Ecuador (Martins et al. 1978; Young 1979); French Guiana (Martins et al. 1978); Trinidad (Young 1979); Peru (Martins et al. 1978; Fraiha et al. 1980a; Young et al. 1985); Bolivia (Young & Morales 1987); Argentina

(Shannon & Del Ponte 1927); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986).

Remarks. We place L. sordellii in the subgenus Sciopemyia because of similarities of female character states, especially the cibarial armature, broad head, spermathecae and long flagellomeres. The male differs from others in this group by lacking persistent setae on the coxite but this is not a significant difference when other characters are considered. Ryan et al. (1987a) isolated trypanosomes from L. sordellii (as nordestina) captured in Brazil.

Young & Morales (1987) studied and figures the male lectotype of L sordellii, noting that one style bears 5 spines that represents an anomaly. The other style has 4 spines.

Lutzomyia (Sciopemyia) fluviatilis (Floch & Abonnenc)

Plate 13-2

Phlebotomus fluviatilis Floch & Abonnenc 1944a: 7 (♂, Canori, French Guiana); 1944b: 1 (♀).

Lutzomyia fluviatilis: Theodor 1965: 196 (listed). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 163 (refs., dist.). Ready et al. 1983: 780 (Pará, Brazil). Young & Arias 1984: 427 (figs., refs.). Ryan 1986: 118 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus fluviatilis: Forattini 1971a: 105 (listed); 1973: 416 (figs., tax.).

Distribution (Map 13-2). French Guiana (Leger et al. 1977, Martins et al. 1978); Brazil (Ready et al. 1983).

Remarks. Floch & Abonnenc (1946b) reported L. fluviatilis biting man and redescribed both sexes in 1952. The fluviatilis-like female from Acre State, Brazil (Arias & Frietas 1982) may represent another microps group species. Trypanosomes were isolated from a single female of L. fluviatilis collected at Jari, Pará, Brazil (Ryan et al. 1987c).

## Lutzomyia (Sciopemyia) preclara Young & Arias

Plate 13-3

Lutzomyia preclara Young & Arias 1984: 429 (♂, Leticia, Amazonas, Brazil). Young & Morales 1987: 658 (♂ figs., ♀ descript.).

Lutzomyia sp. Young & Arias 1984: 426 (Colombia).

Lutzomyia sp. near L. microps Young et al. 1985: 145 (Peru).

Distribution (Map 13-3). Colombia (Young & Arias 1984; Young & Morales 1987); Peru (Young et al. 1985).

## Lutzomyia (Sciopemyia) pennyi Arias & Freitas

Plate 13-4

Lutzomyia pennyi Arias & Frietas 1981: 847 (♂, E of Manaus, Amazonas, Brazil). Young & Arias 1984: 430 (♂ fig.).

Distribution (Map 13-4). Brazil (Arias & Freitas).

## Lutzomyia (Sciopemyia) nematoducta Young & Arias

Plate 13-5

Lutzomyia nematoducta Young & Arias 1984: 428 (♂, ♀ near Manaus, Amazonas, Brazil).

Distribution (Map 13-3). Brazil (Young & Arias 1984).

## Lutzomyia (Sciopemyia) servulolimai Damasceno & Causey

Plate 13-6

Phlebotomus servulolimai Damasceno & Causey 1945: 635 (♂, Bom Jesus, São Domingo, Pará, Brazil).

Lutzomyia servulolimai: Theodor 1965: 182 (listed). Llanos 1973: 34 (♂ figs., Peru). Martins et al. 1978: 168 (dist.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Young & Arias 1984: 426 (full refs., fig.). Ryan 1986: 49 (♂ fig., Pará, Brazil).

Distribution (Map 13-4). Brazil (Martins et al. 1978; Biancardi et al. 1982); Peru (Llanos 1973); Bolivia (Young & Arias 1984).

## Lutzomyia (Sciopemyia) microps (Mangabeira)

Plate 13-6

Flebotomus microps Mangabeira 1942a: 169 (♂, Municip. Nova Iguaca, Rio de Janeiro, Brazil).

Lutzomyia microps: Theodor 1965: 182 (listed). Martins et al. 1975b: 259 (♀ descript., dist.); 1978: 163 (refs., dist.). Mayrink et al. 1979: 131 (Manas Gerais, Brazil). Young & Arias 1984: 425 (♂ figs., refs.). Aguiar & Soucasaux 1984: 199 (biting man, Brazil). Aguiar et al. 1985a: 187; 1985b: 340; 1985c: 467; 1987: 585 (coll. data, Brazil).

Psychodopygus microps: Forattini 1973: 473 (figs., tax.).

Distribution (Map 13-3). Brazil (Martins et al. 1978; Aguiar et al. 1985a).

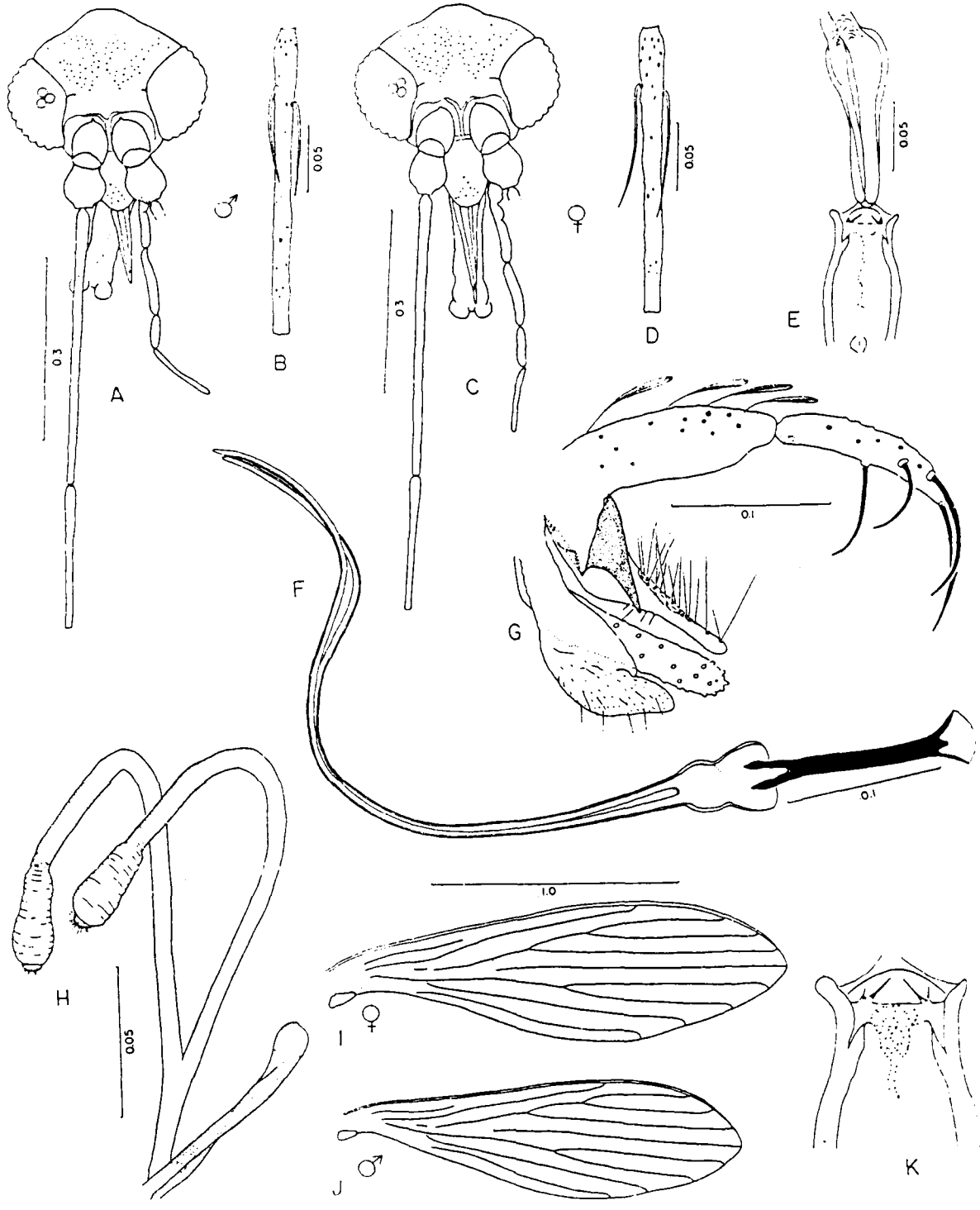
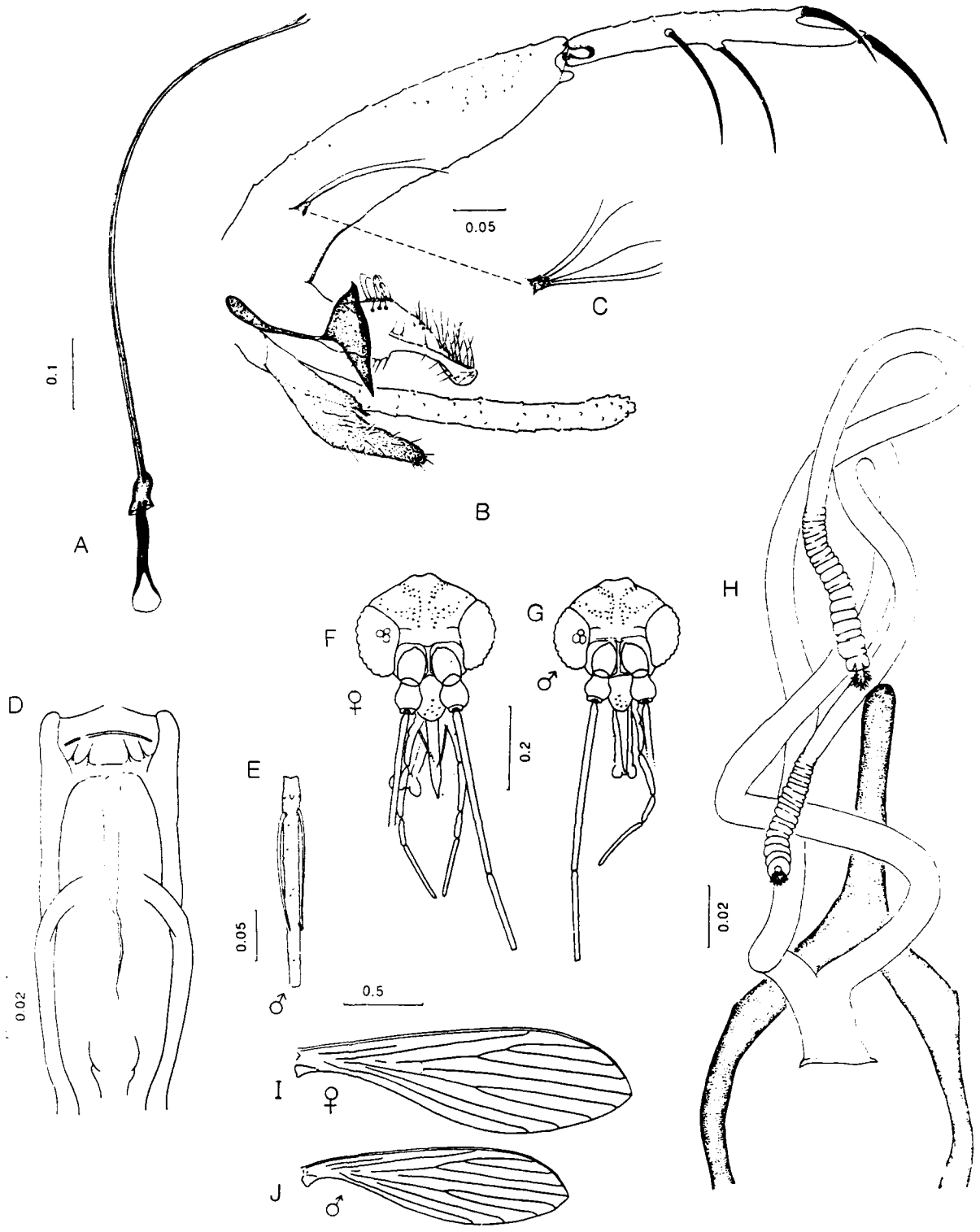



Plate 13-1

Lutzomyia sordellii. A. Male head; B. Male Flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).




Lutzomyia fluviatilis

Plate 13-2

A. Genital pump & filaments; B. Male terminalia; C. Coxite tuft; D. Female cibarium; E. Female flagellomere II; F. Female head; G. Male head; H. Spermathecae; I. Female wing; J. Male wing (from Young & Arias 1984).

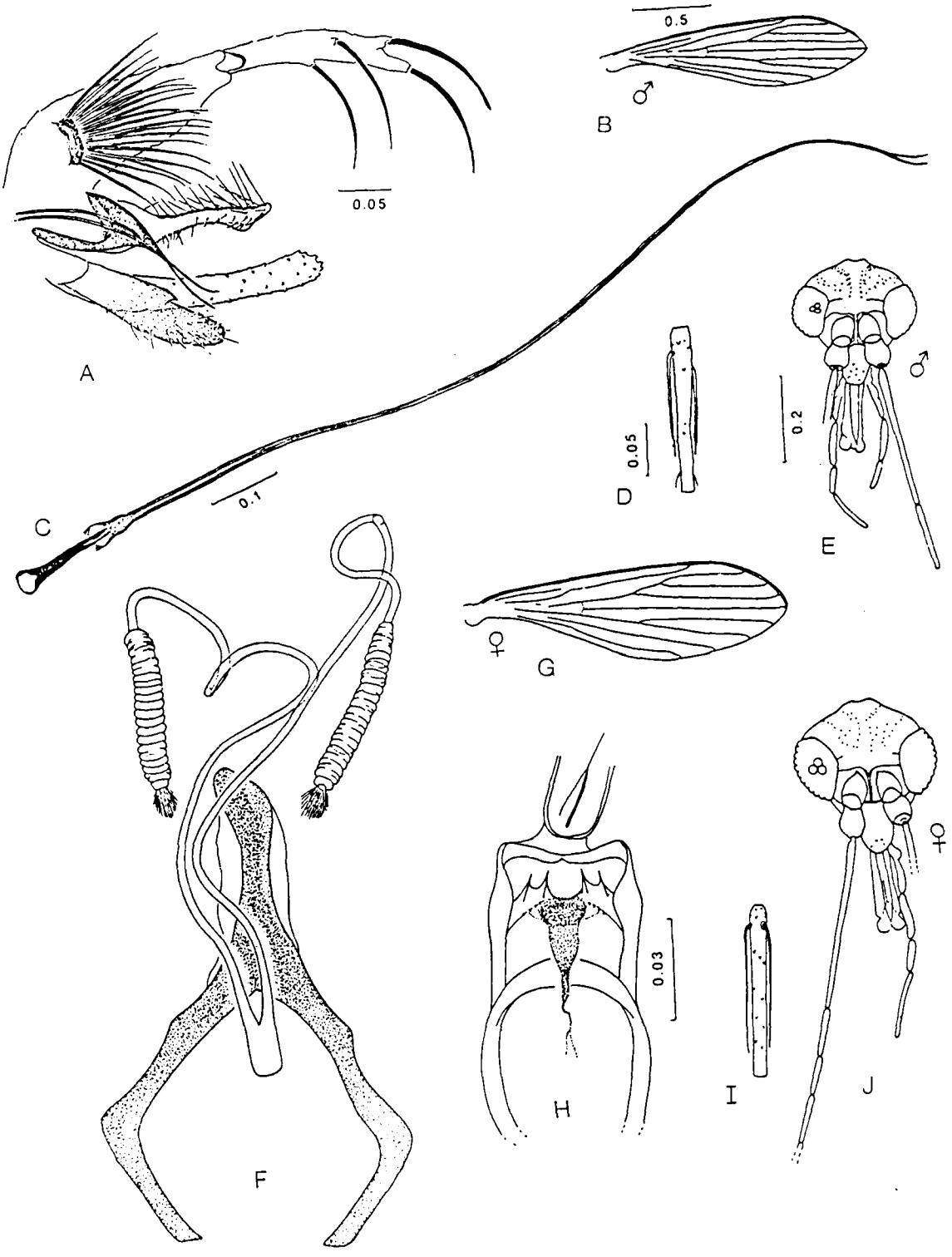



Plate 13-3

Lutzomyia preclara. A. Male terminalia; B. Male wing; C. Ccnital pump & filaments; D. Male flagellomere II; E. Male head; F. Spermathecae; G. Female wing; H. Female cibarium; I. Female flagellomere II; J. Female head (from Young & Morales 1987).

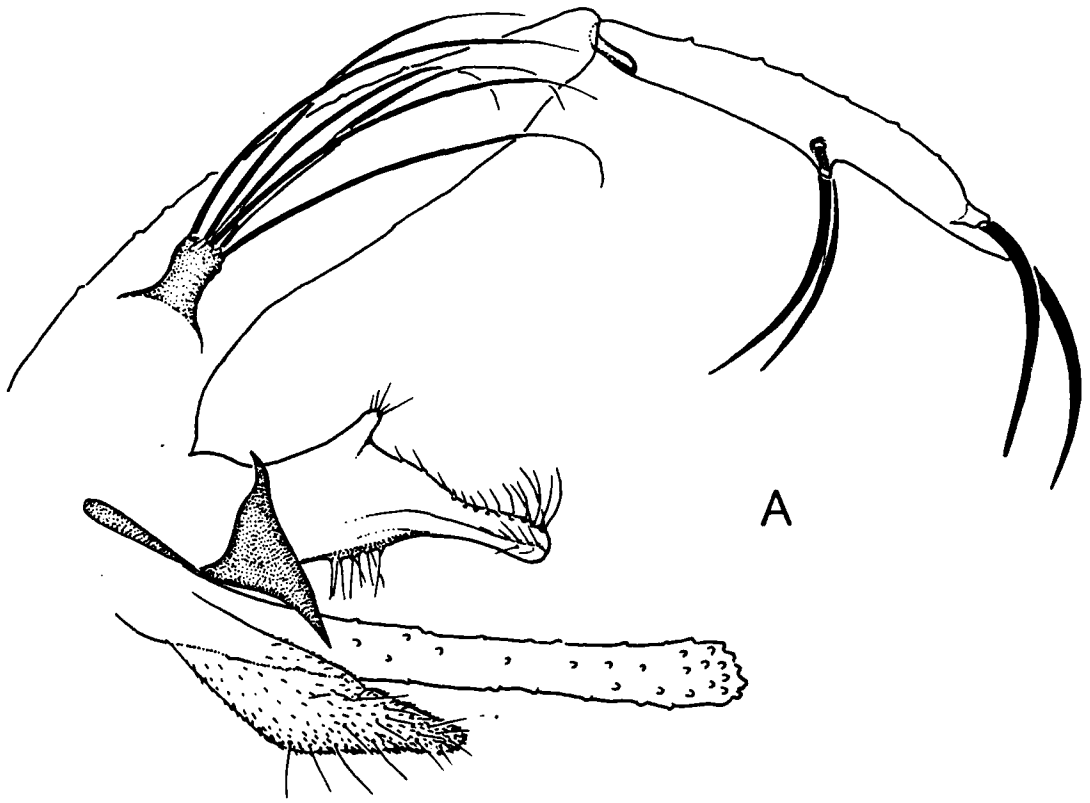



Plate 13 – 4

Lutzomyia pennyi. A. Male terminalia (from Young & Arias 1984).

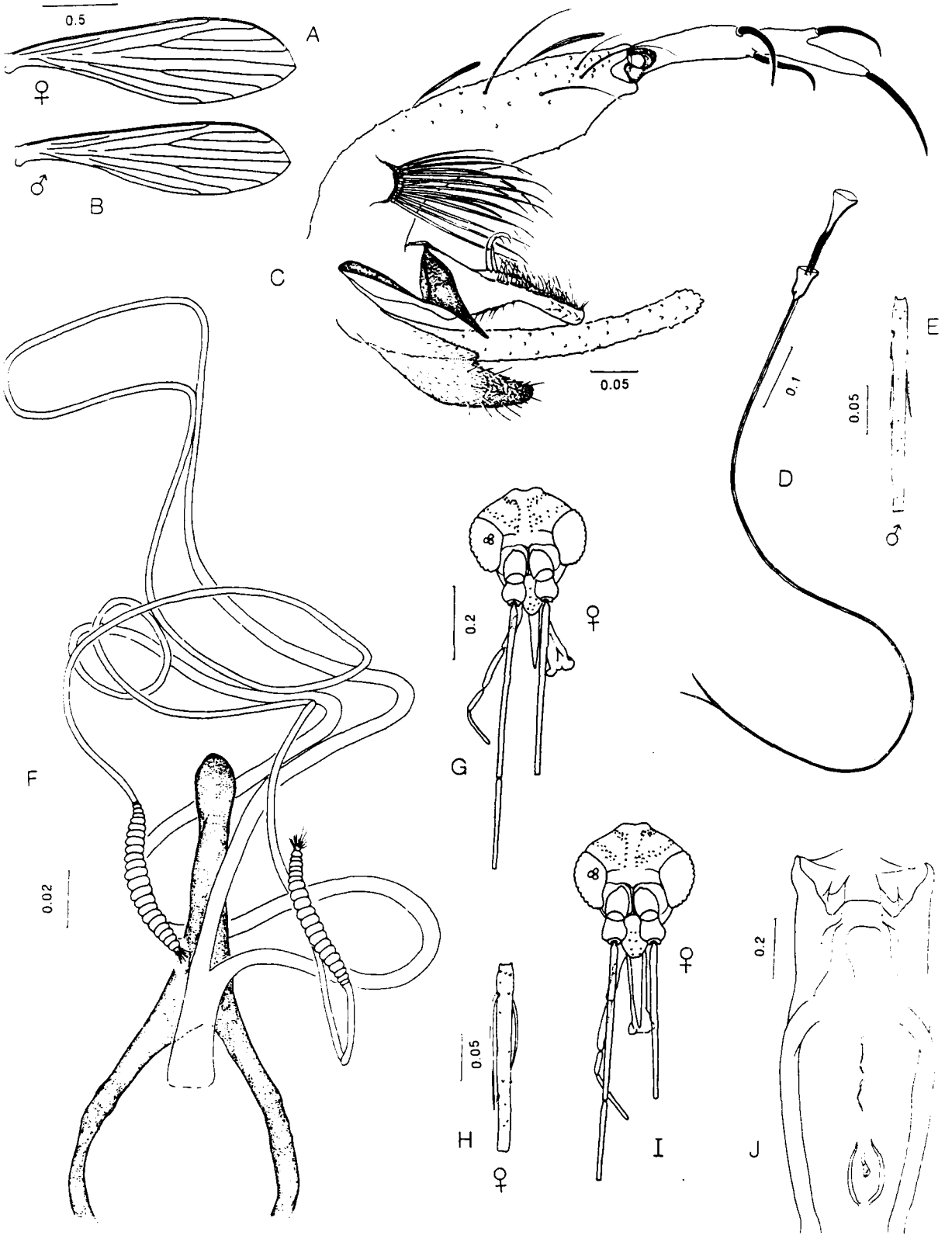



Plate 13-5

Lutzomyia nematoducta

A. Female wing; B. Male wing; C. Male terminalia; D. Genital pump & filaments; E. Male flagellomere II; F. Spermathecae; G. Female head; H. Female flagellomere I; I. Female head; J. Female cibarium (from Young & Arias 1984).

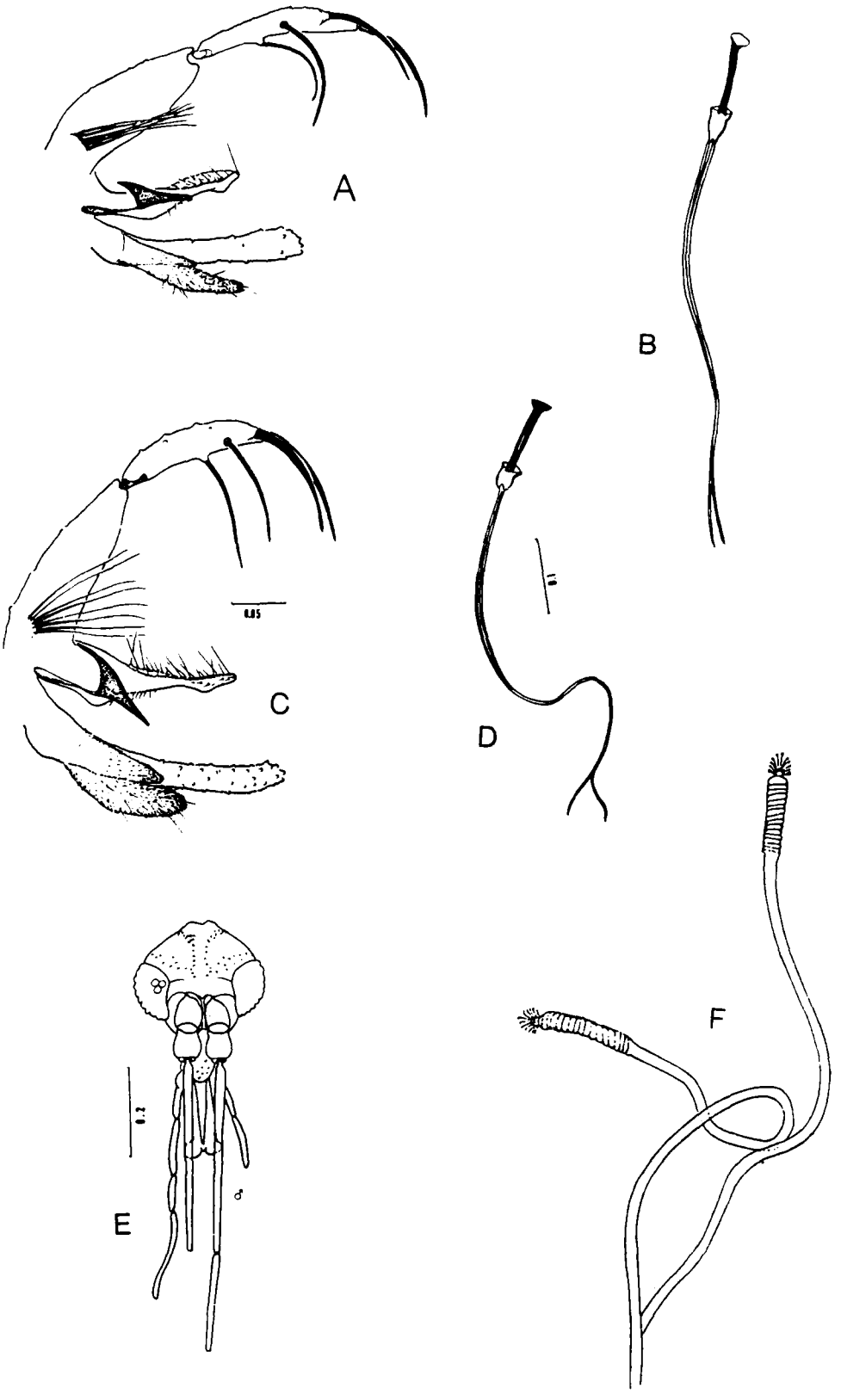



Plate 13-6

Lutzomyia servulolimai. A. Male terminalia; D. Genital pump & filaments (from Arias & Young 1984).

Lutzomyia microps. B. Genital pump & filaments; C. Male terminalia; E. Male head; F. Spermathecae (figs. A-E from Young & Arias 1984; fig. E from Martins et al. 1975b).

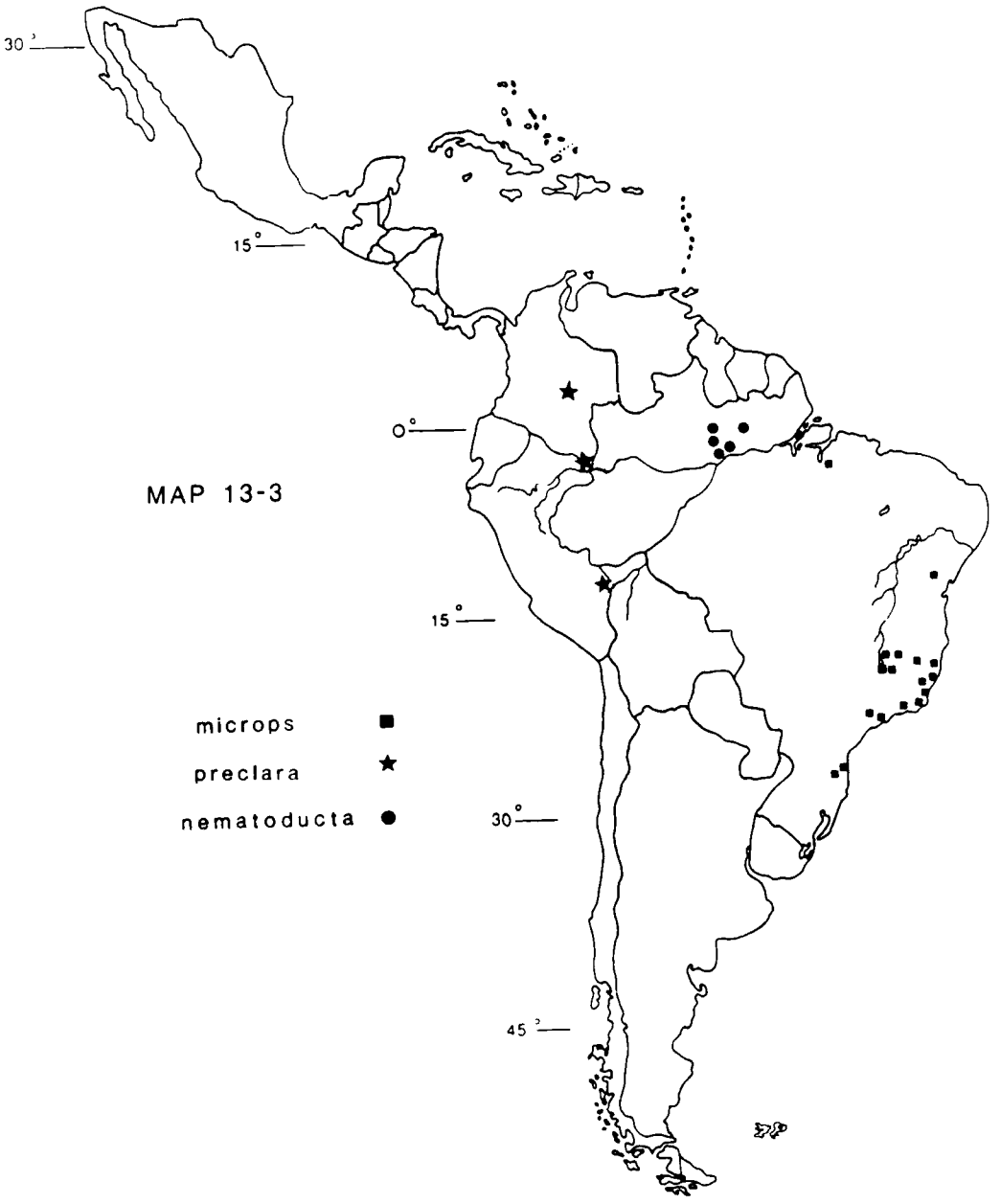



MAP 13-1




MAP 13-2

fluviatilis ✡


30°
15°
0°
15°
30°
45°
MAP 13-3
microps
preclara
nematoducta


30°
15°
0°
15°
30°
45°
MAP 13-4
servuolimai
pennyi

## 14. Lutzomyia Species Group Migonei

Flebotomus subgenus Castromyia Mangabeira 1942a: 185 (type species: Phlebotomus castroi Barretto & Coutinho by orig. designation).

Lutzomyia species group migonei Theodor 1965: 182 (in part). Martins et al. 1978: 135.

Lutzomyia subgenus Barrettomyia Martins & Silva 1968: 3 (type species; Flebotomus tupynambai Mangabeira by orig. designation). Forattini 1971a: 102; 1973: 343.

Lutzomyia subgenus Coromyia: Forattini 1971a: 101; 1973: 273 (in part).

Identification. Coloration pale to dark. Antennal ascoids simple. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 horizontal teeth; number of vertical teeth variable; arch complete; pigment patch well defined or not. Pharynx unarmed. Spermathecae annulated or not, ducts variable in length. ♂ genitalia. Coxite with 1 or more groups of persistent setae. Style with 4 spines (exception is L. bahiensis with 4-8) & small subterminal seta. Paramere simple or divided. Aedeagus either simple or with dorsal projection. Genital filament tips simple or modified. Lateral lobe not inflated, without modified setae.

The migonei group contains at least 3 complexes or series which some authors prefer to separate as distinct groups (e.g., Martins et al. 1978). The spermathecae of L. tupynambai and its allies (subgenus

Barrettomyia Martins & Silva) have expanded individual ducts that may have been derived from L. dubitans-like stock.

Medical Importance: Unknown; several species have been observed biting man and L. migonei females have been found naturally infected with unidentified flagellates. An unidentified female, near L. tupynambai, with Leishmania braziliensis (see Ryan et al. 1987c).

Key to the Males of the Lutzomyia Species Group Migonei*

1. Paramere divided or bifurcate. ..... 2
   Paramere undivided. ..... 3

2. Genital filament tips elongate, spear-shaped; modification comprises about 1/8 total length of filament. ..... L. lenti (Pl. 14-1)
   Genital filament tips otherwise, comprising ca. 1/20 total length of filament. ..... L. carmelinoi (Pl. 14-1)

3. Paramere with dorsal row of 3-5 large setae, modified as shown. ..... L. edwardsi (Pl. 14-2)
   Paramere without such setae. ..... 4

4. Genital filaments 5X length of genital pump or longer. ..... 5
   Genital filaments shorter than 4.5X length of pump. ..... 6

*The male of Lutzomyia sp. of Baduel is not known with certainty.

5. Paramere with median group of 5-8 persistent setae. Genital filaments longer than 6.5X genital pump. ..... L. pacae (Pl. 14-3)

Paramere with median group of 2-4 persistent setae. Genital filaments shorter than 6X genital pump. ..... L. gruta (Pl. 14-4)

6. Genital filament tips simple, not inflated or otherwise modified. ..... 8

Genital filament tips modified or inflated. ..... 10

7. Coxite with setae of basal tuft obviously much shorter than maximum width of coxite. Paramere as shown. ..... L. migonei (Pl. 14-5)

Coxite with setae of coxite tuft longer than maximum width of coxite. Paramere otherwise. ..... 9

8. Paramere with dorsal setae covering at least distal half of structure; ventral projection not acute. ..... L. cortelezzii (Pl. 14-6)

Paramere with dorsal setae restricted to distal fourth of structure; ventral projection acute. ..... L. sallesi (Pl. 14-6)

9. Paramere with ventral hump or acute projection. ..... 11

Paramere without such ventral project. ..... 17

10. Genital filaments longer than 2X length of genital pump. Coxite tuft with most of setae implanted on a common tubercle (costalimai complex). ..... 12

Genital filaments shorter than 2X length of genital pump. Coxite tuft of thinner setae not borne on a common tubercle (walkeri complex, in part). ..... 16

11. Coxite with basal tuft of 3 long setae, 2-3 much shorter setae present. ..... L. tupynambai (Pl. 14-7)
Coxite with basal tuft of 6 or more long setae. ..... 13

12. Coxite tuft & paramere as shown; style usually with 5 or more spines (rarely 4). ..... L. bahiensis (Pl. 14-7)
Coxite tuft & paramere otherwise; style with 4 spines. ..... 14

13. Paramere with isolated setae on dorsal margin. ..... 15
Paramere with numerous (8+) setae on dorsal margin. .....
..... L. callipyga (Pl. 14-8)

14. Paramere with isolated seta implanted on a distinct tubercle.
..... L. costalimai (Pl. 14-8)
Paramere with isolated setae not implanted on a tubercle.
..... L. petropolitana (Pl. 14-8)

15. Aedeagus with dorsal projection. Genital filament tips modified as shown. ..... L. williamsi (Pl. 14-9)
Aedeagus simple, lacking such a projection. Genital filament tips modified otherwise. ..... L. termitophila (Pl. 14-10)

16. Paramere with 1-2 isolated dorsal setae near middle of structure. Genital filament tips as shown. ..... L. sericea (Pl. 14-11)

? L. sp. of Baduel (Pl. 14-12)

Paramere without isolated setae. Genital filament tips otherwise.... 18

17. Paramere with dorsal, setose lobe at level of aedeagus. Coxite tuft of 6-8 thin setae. ..... L. evandroi (Pl. 14-13)

Paramere without such a dorsal lobe. Coxite tuft of 10 or more setae. ..... 19

18. Coxite tuft of 10 or more relatively wide setae as shown. Genital filament tips with a subterminal notch, not inflated. .....

..... L. firmatoi (Pl. 14-14)

Coxite tuft of much thinner setae. Genital filament tips inflated. ..... 20

19. Genital filament tips shaped like a buttonhook, lacking an inner tooth-like structure. Aedegus & paramere as shown. .....

..... L. baculus (Pl. 14-15)

Genital filament tips subspherical with distinct inner tooth-like structure. Aedeagus & paramere otherwise. ..... 21

20. Aedeagus simple. Style with proximal spines paired or nearly paired. Genital filaments longer, ca. 2X length of genital pump. ..... L. dubitans (Pl. 14-16)

Aedeagus with dorsal projection. Style with isolated proximal spine. Genital filaments shorter than 2X length of pump. ..... L. walkeri (Pl. 14-17)

Key to the Females of the Lutzomyia Species Group Migonei*

1. Spermathecae more or less cylindrical, at least 2X longer than wide. ..... 2
   Spermathecae otherwise, subspherical, ovoid or capsule-like, length less than 2X width. ..... 5

2. Spermathecae annulated. ..... 3
   Spermathecae not annulated. ..... 4

3. Common & individual sperm ducts short, subequal in length, without convolutions; spermathecae with terminal knob arising subapically. ..... L. termitophila (Pl. 14-10)
   Common sperm duct 5 or more times longer than convoluted individual ducts; spermathecae with apical terminal knob. ..... L. gruta (Pl. 14-4)

4. Common sperm duct 5 or more times length of individual duct; spermathecae wider as shown. ..... L. pacae (Pl. 14-3)
   Common sperm duct considerably shorter than individual ducts; spermathecae but slightly wider than individual duct width. ..... L. migonei (Pl. 14-5)

---

*The females of L. callipyga.

5. Individual sperm ducts greatly expanded, sac-like in part or whole.
..... L. tupynambai (Pl. 14-7)
L. bahiensis
L. callipyga
L. costalimai
L. petropolitana

Individual sperm ducts not expanded. ..... 6

6. Spermathecae with distinct terminal knob. ..... 7

Spermathecae without terminal knob, the "hairs" (ducts) arising directly from spermathecae. ..... L. firmatoi (Pl. 14-14)

7. Common & individual sperm ducts subequal in length. ..... 8

Common duct much shorter than individual ducts. ..... 9

8. Individual sperm ducts about half as wide as common duct width.
..... L. dubitans (Pl. 14-16)

Individual sperm ducts more slender, about one third as wide as common duct. ..... L. walkeri (Pl. 14-17)

9. Individual sperm ducts tapered, width near spermathecae much shorter than width near junction with common duct. ..... 10

Individual sperm ducts more or less subequal in width throughout.
..... 12

10. Spermathecae relatively small, maximum width = to or less than maximum width of individual duct. ..... L. sericea (Pl. 14-11)

Spermathecae wider than maximum width of individual duct.
..... 11

11. Spermathecae somewhat pear-shaped; terminal knob arises off center when viewed at certain angles. ..... L. baculus (Pl. 14-15)
Spermathecae otherwise; terminal knob arises centrally from spermathecae. ..... L. edwardsi (Pl. 14-2)
Lutzomyia sp. of Baduel (Pl. 14-12)

12. Common duct width subequal to width of genital fork stem.
..... L. sallesi (Pl. 14-6)
L. cortelezzii
Common duct much wider than width of genital fork stem. ..... 13

13. Spermathecae relatively large, its length subequal to width of common duct. ..... L. williamsi (Pl. 14-9)
Spermathecae smaller, its length obviously much less than width of common duct. ..... 14

14. Common sperm duct shorter than 1/6 length of individual duct; spermathecae subspherical. ..... L. evandroi (Pl. 14-13)
Common sperm duct longer than 1/3 length of individual duct; spermathecae wider at base than apically, somewhat bell-shaped.
..... L. lenti
L. carmelinoi (Pl. 14-1)

Lutzomyia lenti (Mangabeira)

Plate 14-1

Flebotomus lenti Mangabeira 1938: 350 (♂, Lassance, Minas Gerais, Brazil). Barretto 1947a: 207 (refs.).

Phlebotomus lenti: Floch & Abonnenc 1952: 33 (figs., keyed). Deane & Deane 1957: 226 (Ceará, Brazil). Sherlock 1957: 78 (♀, immatures). Carnheiro & Sherlock 1964: 315 (pupa, keyed). Mangabeira 1969: 21 (♂ fig.).

Lutzomyia lenti: Martins et al. 1962b: 380 (Goias, Brazil). Theodor 1965: 182. Lewis 1967b: 131 (♀ figs., tax.). Forattini 1973: 287 (figs., review). Velasco & Trapido 1974: 433 (cf. to boliviana). Lewis 1975a: 500 (mouthpart morphol.). Martins et al. 1978: 133 (dist.). Mayrink et al. 1979: 131 (natural bacterial infection, Brazil). Ryan et al. 1986: 326 (figs., keyed).

Lutzomyia lentiodes Forattini 1971a: 103 (new name for pinottii Lucena, not pinottii Damasceno & Arouck). Martins et al. 1978: 134 (as synonym of lenti).

Distribution (Map 14-1). Brazil (Martins et al. 1978).

Remarks. Based on observations by Ryan et al. (1986) on variation of the length of genital filaments, it is probable that L. lenti is a senior synonym of L. lentiodes Forattini, first described as P. pinottii by

Lucena (1960). This latter name, however, was applied first to another sand fly in the subgenus Evandromyia (see p. 370).

## Lutzomyia carmelinoi Ryan, Fraiha, Lainson & Shaw

Plate 14-1

Lutzomyia sp. n. 222.12 Ryan 1986: 54 (♂, ♀ figs.).

Lutzomyia carmelinoi Ryan, Fraiha, Lainson & Shaw 1986: 323 (♂, ♀, Santarém, Pará, Brazil).

Distribution (Map 14-1). Brazil (type locality).

Remarks. Slight differences in the length and shape of the genital filament tips are used to distinguish males of this species from L. lenti. The females are very similar in structure; Ryan et al. (1986) separate them by the ratio of the widths of the common and individual sperm ducts but we key L. lenti and L. carmelinoi together in the same couplet to emphasize that associated males must be on hand before definitive identifications can be made.

## Lutzomyia edwardsi (Mangabeira)

Plate 14-2

Flebotomus edwardsi Mangabeira 1941a: 201 (♂, ♀, Nova Iguassú, Rio de Janeiro, Brazil). Barretto 1947a: 197 (refs.).

Phlebotomus edwardsi: Barretto 1950a: 106 (keyed); 1951: 216 (dist.).

Lutzomyia edwardsi: Theodor 1965: 182. Forattini 1973: 284 (figs., tax.). Leger et al. 1977: 220 (? probably misident.). Martins et al. 1978: 137 (dist.). Mayrink et al. 1979: 131 (natural trypanosome infections, Minas Gerais, Brazil). Gomes et al. 1986: 282 (Sao Paulo, Brazil).

Distribution (Map 14-2). Brazil (Martins et al. 1978).

Remarks. Leger et al. (1977) illustrated a female from French Guiana, identifying it as L. edwardsi, but this record is well outside the geographic range of L. edwardsi and no males were reported. We consider its presence in French Guiana as doubtful.

## Lutzomyia pacae (Floch & Abonnenc)

Plate 14-3

Phlebotomus pacae Floch & Abonnenc 1943a: 1 (♂, ♀, Montabo, Cayenne, French Guiana); 1952: (♂ ♀, redescript.). Wijers & Linger 1966: 505 (Suriname, biting man).

Flebotomus ferreirai Causey & Damasceno 1945b: 668 (♂, Peixe-Boi, Pará, Brazil). Barretto 1950a: 221 (as synonym of pacae).

Lutzomyia pacae: Martins et al. 1963: 334 (Roraima, Brazil). Theodor 1965: 182 (listed). Forattini 1971a: 101; 1973: 288 (♂, ♀ figs., tax.). Shaw & Lainson 1972: 711 (Pará, Brazil). Ward et al. 1973: 178 (♀♀

attracted to rodent bait, Brazil). Lewis 1975a: 500 (mouthpart morphol.). Leger et al. 1977: 218 (French Guiana). Arias & Freitas 1977: 511 (Amazonas, Brazil); 1978: 391 (negative for flagellates). Martins et al. 1978: 139 (refs., dist.). Lainson et al. 1979: 241 (negative for flagellates, Brazil). Ready et al. 1983: 708 (Pará, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ready et al. 1986: 29 (Pará, Brazil). Ryan 1986: 57 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 14-3). Suriname (Wijers & Linger 1966); French Guiana (Martins et al. 1978; Leger et al. 1977); Brazil (Martins et al. 1978; Arias & Freitas 1977, 1978; Ryan 1986).

Remarks. Females of L. pacae are regarded as rodentophilic (Ready et al. 1983) but will occasionally bite man.

## Lutzomyia gruta Ryan

Plate 14-4

Lutzomyia gruta Ryan 1986: 109 (♂, ♀, Serra dos Carajás, Pará, Brazil).

Distribution (Map 14-2). Brazil (type locality).

Remarks. Ryan (1986) assigned L. gruta to the verrucarum species group, presumably on the basis of the finely annulated spermathecae, cibarial armature and some features of the male terminalia which, nevertheless, greatly resembles that of L. pacae in the migonei group. Apart from the

annulated spermathecae of L. gruta, the females of these species are structurally similar and for the present, at least, we place L. gruta in the migonei group.

## Lutzomyia migonei (Franca)

Plate 14-5

Phlebotomus migonei Franca 1920: 230 (♂, Asunción, Paraguay).

Phlebotomus rangeli Nunez-Tóvar 1924: 45 (♂, ♀, Aragua, Venezuela). Dyar 1929: 120 (as synonym of migonei).

Phlebotomus araozi Paterson & Shannon 1926: 236 (♂, ♀, Argentina). Dyar 1929: 120 (as synonym of migonei).

Flebotomus migonei: Barretto 1947a: 211 (full refs., synonyms).

Lutzomyia migonei: Forattini 1973: 274 (figs., tax., gen. review). Mogollon et al. 1977: 209 (Venezuela). Martins et al. 1978: 138 (figs., dist., refs.). Ramirez Perez et al. 1978: 52 (figs., Aragua, Venezuela); 1981: 124 (Venezuela); 1982a: 14 (figs., Sucre, Venezuela). Young 1979: 63 (refs., figs.). Mayrink et al. 1979: 131 (bacterial, fungal infections, Brazil). Feliciangeli 1980: 246 (figs., keyed). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Llanos 1981: 183 (Peru). Arias & Freitas 1982a: 402 (Acre, Brazil). Bonfante Garrido 1983: 740; 1984: 850 (Venezuela). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Barros et al. 1985: 150 (Espirito Santo, Brazil). Gomes et

al. 1986: 282 (ecology, Brazil). Ryan 1986: 56 (figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil).

Distribution (Map 14-4). Colombia (Young 1979); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1981; 1982a; Bonfante Garrido 1983); Brazil; Argentina; Paraguay (Martins et al. 1978); Peru (Llanos 1981; Young et al. 1985); Trinidad (Young 1979).

Remarks. Forattini (1973) reviewed the habits of this anthropophilic species which has been found naturally infected with unidentified flagellates in Venezuela and Brazil (see Johnson et al. 1963).

## Lutzomyia cortelezzii (Brethes)

Plate 14-6

Phlebotomus cortelezzii Brethes 1923: 361 (♂, ♀, La Plata, Argentina). Theodor 1932: 21 (figs., tax.).

Flebotomus cortelezzii: Barretto 1947a: 194 (refs.).

Lutzomyia cortelezzii: Theodor 1965: 182 (listed).

Distribution (Map 14-5). Argentina; Uruguay; ? Peru (Martins et al. 1978, in part).

Remarks. Theodor (1932) redescribed the male and female of L. cortelezzii from specimens taken in Argentina. Later, L. sallesi was described from

Brazil by Galvao & Coutinho (1939). Several authors (see Forattini 1973) consider the taxa to be conspecific, but we follow Martins et al. (1978) who treat them as distinct species. Theodor (in lit. to G.B. Fairchild, 15 Jan. 1969) pointed out differences between the males of these species. He wrote that the paramere of L. sallesi "has a rounded head with a pointed ventral process and a ventral row of fine setae; cortelezzii has a blunt ventral process and a dorsal row of strong setae -- I am inclined to restrict cortelezzii to Argentina and Uruguay and consider the records from Brazil as sallesi."

One male that we examined from northern Argentina (El Palmar, Salta) agrees in structure with L. sallesi, so evidently not all Argentina specimens represent L. cortelezzii. We have not observed males from Peru; the figures of Llanos (1973), drawn from males captured in Madre de Dios Department, resemble L. sallesi more closely than L. cortelezzii.

## Lutzomyia sallesi (Galvao & Coutinho)

Plate 14-6

Flebotomus sallesi Galvao & Coutinho 1939: 125 (♂, ♀, Aracatuba, Sao Paulo, Brazil). Barretto 1947a: 221 (full refs.).

Lutzomyia sallesi: Martins et al. 1962d: 381 (Goias, Brazil); 1964a: 129 (Acre, Brazil). Velasco 1973: 75 (♂, ♀, Bolivia). Forattini 1973: 284 (in part, as junior synonym of cortelezzii). Martins et al. 1978: 139

(dist.). Mayrink et al. 1979: 131 (♀, natural infection Trypanosoma, Brazil).

Lutzomyia cortelezzii, not cortelezzii Brethes): Llanos 1973: 31 (♂, ♀ figs., Peru). ? Martins et al. 1976a: 488 (Huánuco, Peru). Galati et al. 1985: 261 (Mato Grosso do Sul, Brazil).

Distribution (Map 14-6). Brazil (Martins et al. 1978); Bolivia (Velasco 1973); Argentina (1 ♂, El Palmar, Salta, 1960, Garcia, coll.); Paraguay (? ♀, Acá-Poi, San Pedro, 1950, M. Hertig); Peru (Llanos 1973; ? Llanos 1981).

Remarks. Arzube (1960) reported L. sallesi from Guayas Prov., Ecuador but this is a very questionable record (Young & Rogers 1984).

The females of L. sallesi and L. cortelezzii appear to be structurally indistinguishable.

## Lutzomyia tupynambai (Mangabeira)

Plate 14-7

Flebotomus tupynambai Mangabeira 1942a: 181 (♂, Cardosa Moreira, Rio de Janeiro, Brazil).

Phlebotomus tupynambai: Mangabeira & Sherlock 1961: 268 (cf. to bahiensis). Sherlock & Carnheiro 1962: 423 (♀). Carnheiro & Sherlock 1964: 314 (pupa).

Sergentomyia tupynambai: Barretto et al. 1956: 49 (variation).

Lutzomyia tupynambai: Theodor 1965: 191 (♂, ♀ figs.). Martins & Silva 1965: 273; 1968: 12 (♂ keyed). Forattini 1973: 347 (figs., tax.). Martins et al. 1973b: 422. Lewis 1975a: 503 (mouthpart morphol.). Martins et al. 1978: 120 (♂, ♀ figs., dist.). Mayrink et al. 1979: 131 (on human bait, Minas Gerais, Brazil). Vexenat et al. 1986a: 296 (Bahia, Brazil).

Distribution (Map 14-7). Brazil (Martins et al. 1978; Vexenat et al. 1986a).

Remarks. The female spermathecae (Pl. 14-7) was drawn from a specimen taken near Tres Bracos, Bahia, Brazil, where males of both L. bahiensis and L. tupynambai have been reported. It is impossible to identify this female to species because it was captured without males and, structurally, the females of these taxa are indistinguishable.

## Lutzomyia bahiensis (Mangabeira & Sherlock)

Plate 14-7

Phlebotomus bahiensis Mangabeira & Sherlock 1961: 266 (♂, Salvador, Bahia, Brazil). Sherlock & Carneiro 1962: 423 (♀). Sherlock & Carneiro 1963: 491 (immatures). Sherlock 1963: 50 (♂ variation). Carneiro & Sherlock 1964: 315 (pupa).

Lutzomyia bahiensis: Theodor 1965: 191. Martins & Silva 1968: 5 (class.). Forattini 1973: 344 (review, figs.). Martins et al. 1978: 118 (dist.). Vexenat et al. 1986a: 296 (Bahia, Brazil).

Distribution (Map 14-5). Brazil (Martins et al. 1978).

Remarks. The males of L. bahiensis show considerable variation in the number of spines on their styles, with 80% of specimens having 6 and the remaining 20% having 4 to 8 (Sherlock 1963).

## Lutzomyia callipyga Martins & Silva

Plate 14-8

Lutzomyia callipyga Martins & Silva 1965: 272 (♂, ♀, Mata dos Frois, Minas Gerais, Brazil); 1968: 12 (♂ keyed). Martins & Morales-Farias 1972: 367. Forattini 1973: 346. Martins et al. 1978: 118 (dist.).

Distribution (Map 14-5). Brazil (Martins et al. 1978).

## Lutzomyia costalimai (Mangabeira)

Plate 14-8

Flebotomus costalimai Mangabeira 1942a: 177 (♂, Cardoso Moreira, Rio de Janeiro, Brazil).

Phlebotomus costalimai: Vargas & Najera 1951a: 22 (cf. to pratti). Mangabeira & Sherlock 1961: 268 (cf. to bahiensis). Sherlock & Carnheiro 1962: 426. Llanos 1964: 381.

Lutzomyia costalimai: Theodor 1965: 191. Martins & Silva 1968: 10 (♀). Martins & Morales-Farias 1972: 367. Forattini 1973: 347. Martins et al. 1978: 118 (dist.).

Distribution (Map 14-8). Brazil (Martins et al. 1978).

## Lutzomyia petropolitana Martins & Silva

Plate 14-8

Lutzomyia petropolitana Martins & Silva 1968: 6 (♂, ♀, Meio da Serra, Rio de Janeiro, Brazil. Forattini 1973: 347 (♂ fig.). Martins et al. 1978: 118.

Distribution (Map 14-5). Brazil (type locality).

## Lutzomyia williamsi (Damasceno, Causey & Arouck)

Plate 14-9

Flebotomus williamsi Damasceno, Causey & Arouck 1945: 1 (♂, Tucunduba, Belém, Pará, Brazil). Damasceno et al. 1949: 835.

Phlebotomus williamsi: Fairchild & Hertig 1952a: 516; 1961: 254 (cf. to walkeri). Sherlock 1962: 327.

Lutzomyia williamsi: Barretto 1962: 98. Theodor 1965: 182. Lewis 1967b: 134. Martins & Morales-Farias 1972: 367. Martins et al. 1978: 135. Ryan 1986: 60 (♂, ♀ figs.). Ryan et al. 1986: 325 (♀ descript.).

Distribution (Map 14-6). Brazil (Ryan 1986; ♂, ♀, Ducke Reserve, Amazonas, 1977, J. Arias; ♂, 27 km SE of Marabá, Pará, 1972, D.G. Young).

Remarks. The aedeagus of the L. williamsi holotype (Pl. 14-9) has a pointed dorsal projection, shown arising from the paramere by Ryan (1986). We studied other males from Amazonas, Brazil (Labrea, Oct. 1972, D.G. Young), and Madre de Dios, Peru (Tambopata Reserve, Nov. 1983, T. Erwin), that differ from the holotype of L. williamsi in having a shorter projection of the aedeagus and an acute, not rounded, ventral projection of the paramere. We refrain from naming this form until more material, especially associated females, becomes available.

The sexes of L. williamsi are properly associated following Ryan (1986) and our own analysis of collections from the Ducke Reserve, Amazonas, Brazil, were males and females have been taken in the absence of closely related species in the migonei group.

## Lutzomyia termitophila Martins, Falcao & Silva

Plate 14-10

Lutzomyia termitophila Martins, Falcao & Silva 1964a: 309 (♂, Confins, Minas Gerais, Brazil); 1965: 4 (Rondonia, Brazil). Martins & Silva 1968: 4. Forattini 1973: 356 (♂ fig.). Martins et al. 1977c: 645 (♀ descript.); 1978: 168 (dist.). Mayrink et al. 1979: 131 (bacterial infection, Minas Gerais, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil).

Distribution (Map 14-9). Brazil (Martins et al. 1978; Biancardi et al. 1982; ♀♀, Tres Bracos, Bahia, 1985-1986, A.L. Hoch).

Lutzomyia sericea (Floch & Abonnenc)

Plate 14-11

Phlebotomus sericeus Floch & Abonnenc 1944a: 6 (♂, Baduel, French Guiana); 1952: 95 (redescript.).

Flebotomus deanei Damasceno, Causey & Arouck 1945: 5 (♂, Pará, Brazil). Theodor 1965: 181 (as synonym of sericea).

Lutzomyia sericea: Barretto 1962: 98 (listed). Martins & Silva 1964: 129 (Acre, Brazil). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 134 (dist.). Arias & Freitas 1982: 401 (Acre, Brazil). Young & Rogers 1984: 599 (Ecuador). Ryan 1986: 58 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1986: 325 (♂, ♀ figs.). Lebbe et al. 1987: 29 (computer aided ident.). Young & Morales 1987: 664 (o fig.).

Distribution (Map 14-8). French Guiana (Legér et al. 1977; Martins et al. 1978); Brazil (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986; ♂♂, ♀♀, vicinity of Manaus, Amazonas, 1977-1981, J. Arias); Ecuador (Young & Rogers 1984).

Remarks. The female of L. sericea, figured by Ryan (1986), appears to be correctly associated with the male. Similar females were captured with

only males of L. sericea near Manaus, Brazil, in horse-bait collections (J. Arias, pers. comm.).

It remains to be established whether Lutzomyia sp. of Baduel (Floch & Abonnenc) is conspecific with L. sericea.

Lutzomyia sp. of Baduel (Floch & Abonnenc)

Plate 14-12

Phlebotomus sp. de Baduel of Floch & Abonnenc 1945b: 1 (♀, Baduel, French Guiana); 1952: 190 (redescript.). Forattini 1960: 480 (Amapa, Brazil).

Lutzomyia sp. de Baduel: Theodor 1965: 196 (listed). Martins et al. 1965: 4 (Rondonia & Maranhao, Brazil). Leger et al. 1977: 222 (as ♀ of sericea). Martins et al. 1978: 135. Young 1979: 66 (? ♀, Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil); Ready et al. 1983: 780 (Pará, Brazil). Ryan 1986: 58 (mention). Ready et al. 1986: 329 (as probable ♀ of sericea).

Distribution (Map 14-10). French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Brazil (above refs.); Colombia (? Osorno et al. 1972a); Suriname (♂♂♀♀, Patamacca Dist., at Marowyne, March 1984).

Remarks. The status of Lutzomyia sp. of Baduel remains uncertain and some of the literature citations given here may not represent this informally named species. A female from Vichada Department, Colombia, listed by Osorno et al. (1979) and illustrated by Young (1979) more closely

resembles L. sp. of Baduel than the female of L. sericea (Pl. 14-11), also figured by Ryan 1986. The Colombian female may be conspecific with an unnamed male, very similar to L. sericea, captured near Vichada and figured by Young & Morales (1987) and duplicated on Plate 14-12.

According to F. Le Pont (pers. comm.) the L. sericea female (Ryan 1986) "has never been collected in French Guiana where the male of L. sericea was described. . . . the spermathecae of the L. sericea female and L. sp. de Baduel are very distinct." Comparisons of Plates 14-11 & 14-12 show these differences of the spermathecae and ducts.

## Lutzomyia evandroi (Costa Lima & Antunes)

Plate 14-13

Phlebotomus evandroi Costa Lima & Antunes 1936: 419 (♂, ♀, Macejana, Ceara, Brazil). Lucena 1953: 92 (♂, ♀, redescript.). Deane & Deane 1957: 226. Mangabeira 1969: 21 (Ceará, Brazil, figs.).

Lutzomyia evandroi: Martins et al. 1962b: 381 (♂, redescript., figs.). Theodor 1965: 182 (fig., spermatheca). Lewis 1967b: 131. Forattini 1973: 286 (figs., tax.). Lewis 1975a: 500 (mouthpart morphol.). Martins et al. 1978: 132 (dist.). Brazil & Ryan 1984: 375 (natural gregarine infection). Ryan 1986: 55 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil).

Distribution (Map 14-11). Brazil (Martins et al. 1978; Brazil & Ryan 1984; Ryan 1986).

## Lutzomyia firmatoi (Barretto, Martins & Pellegrino)

Plate 14-14

Sergentomyia firmatoi Barretto, Martins & Pellegrino 1956. Folia Clin. Biol. 26: 50 (♂, Jampruca, Minas Gerais, Brazil, no figs.); 1958: 185 (duplicate descript., with figs.).

Lutzomyia firmatoi: Martins et al. 1961c: 310 (Paraná & Santa Catarina, Brazil). Theodor 1965: 182 (provisionally placed in migonei group). Forattini 1973: 255 (♂ fig., tax.). Martins et al. 1975b: 262 (♀ descript., dist.); 1978: 163 (refs., dist.). Mayrink et al. 1979: 131 (natural infections, trypanosomes, gregarines, Minas Gerais, Brazil).

Distribution (Map 14-12). Brazil (Martins et al. 1978; ♀, Cortes Pedra, Bahia, 1986, A.L. Hoch).

Remarks. The female of L. firmatoi lacks a terminal knob of the spermatheca, unlike other species in this group, but resembles them in other structural features.

## Lutzomyia baculus Martins, Falcao & Silva

Plate 14-15

Lutzomyia baculus Martins, Falcão & Silva 1965: 10 (♂, Guajará-Mirim, Rondonia, Brazil). Martins et al. 1978: 161 (dist.). Ryan et al. 1986: 325 (♀ descript., Pará, Brazil).

Lutzomyia bacula: Forattini 1973: 349 (♂ fig.). Biancardi et al. 1982: 171 (Rondonia, Brazil). Ryan 1986: 53 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 14-5). Brazil (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986; ♂♂, ♀♀, Ducke Reserve, Amazonas, 1978, J. Arias).

## Lutzomyia dubitans (Sherlock)

Plate 14-16

Phlebotomus dubitans Sherlock 1962: 324 (♂, San Vicente de Chucuri, Santander, Colombia). Forattini 1973: 292 (as synonym of walkeri, marajoensis).

Phlebotomus marajoensis (not marajoensis Damasceno & Causey): Fairchild & Hertig 1961b: 250 (tax., ♂, ♀ figs.).

Lutzomyia marajoensis (not marajoensis Damasceno & Causey): Theodor 1965: 182 (listed). Martins et al. 1978: 134 (dist.). Ramirez Perez et al. 1978: 49 (♂, ♀ figs., Aragua, Venezuela); 1981: 124 (Venezuela); 1982a: 14 (figs., Sucre, Venezuela). Young 1979: 63 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (figs., keyed). Murillo & Zeledón 1985: 68 (♂, ♀ figs., Costa Rica).

Lutzomyia dubitans: Theodor 1965: 182 (listed). Feliciangeli 1985: 307 (tax., figs., as valid species). Ryan et al. 1986: 328 (keyed, figs.). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Carabobo, Venezuela).

Distribution (Map 14-10). Costa Rica (Murillo & Zeledón); Panama (Martins et al. 1978); Colombia (Young 1979); Venezuela (Martins et al. 1979; Ramirez-Perez et al. 1978; 1981; 1982b); Trinidad (Fairchild & Hertig 1961b); Brazil (Feliciangeli 1985).

Remarks. Feliciangeli (1985) carefully studied several species in the migonei group, series walkeri, concluding that L. marajoensis is a junior synonym of L. walkeri. Furthermore, she correctly resurrected L. dubitans (Sherlock), a species previously considered to be conspecific with L. marajoensis by most authors.

## Lutzomyia walkeri (Newstead)

Plate 14-17

Phlebotomus walkeri Newstead 1914: 188 (♂, ♀, Rio Abuna, Bolivia-Brazil boundary).

Phlebotomus marajoensis Damasceno & Causey 1944: 339 (♂, Ilha do Marajó, Brazil). Forattini 1973: 292 (as synonym of walkeri).

Lutzomyia marajoensis: Barretto 1962: 98. Martins et al. 1963: 334 (Brazil records). Feliciangeli 1985: 307 (as synonym or walkeri, refs., figs.).

Phlebotomus gasti Sherlock 1962: 326 (♂, San Vicente de Chucuri, Santander, Colombia).

Lutzomyia walkeri: Barretto 1962: 98 (listed). Llanos 1973: 31 (figs., Peru). Martins et al. 1978: 135 (dist.). Leger et al. 1977: 31 (? French Guiana). Martins et al. 1978: 135 (refs., dist., figs.). Young 1979: 67 (refs., figs.). Morales et al. 1981: 201 (Tolima, Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982a: 402 (Acre, Brazil). Morales et al. 1984: 37 (lab rearing). Young & Rogers 1984: 559 (listed, Ecuador). Feliciangeli 1985: 307 (tax., figs.). Ryan et al. 1986: 326 ( figs., keyed). Ryan 1986: 59 (figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Lutzomyia gasti: Martins et al. 1978: 133 (dist.).

Distribution (Map 14-13). Panama (Christensen 1972a); Colombia (Young 1979; Morales & Minter 1981: 96, ? Caqueta, Colombia; Morales et al. 1981); Venezuela (Feliciangeli 1985); Trinidad (Young 1979); French Guiana (Leger et al. 1977); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982a; Ryan 1986); Ecuador (Young 1979); Peru (Llanos 1981); Bolivia; Paraguay (Martins et al. 1978).

Remarks. The relatively broad dorsal projection of the aedeagus of L. walkeri is characteristic of this species. Both sexes are often found in large numbers near chickens.

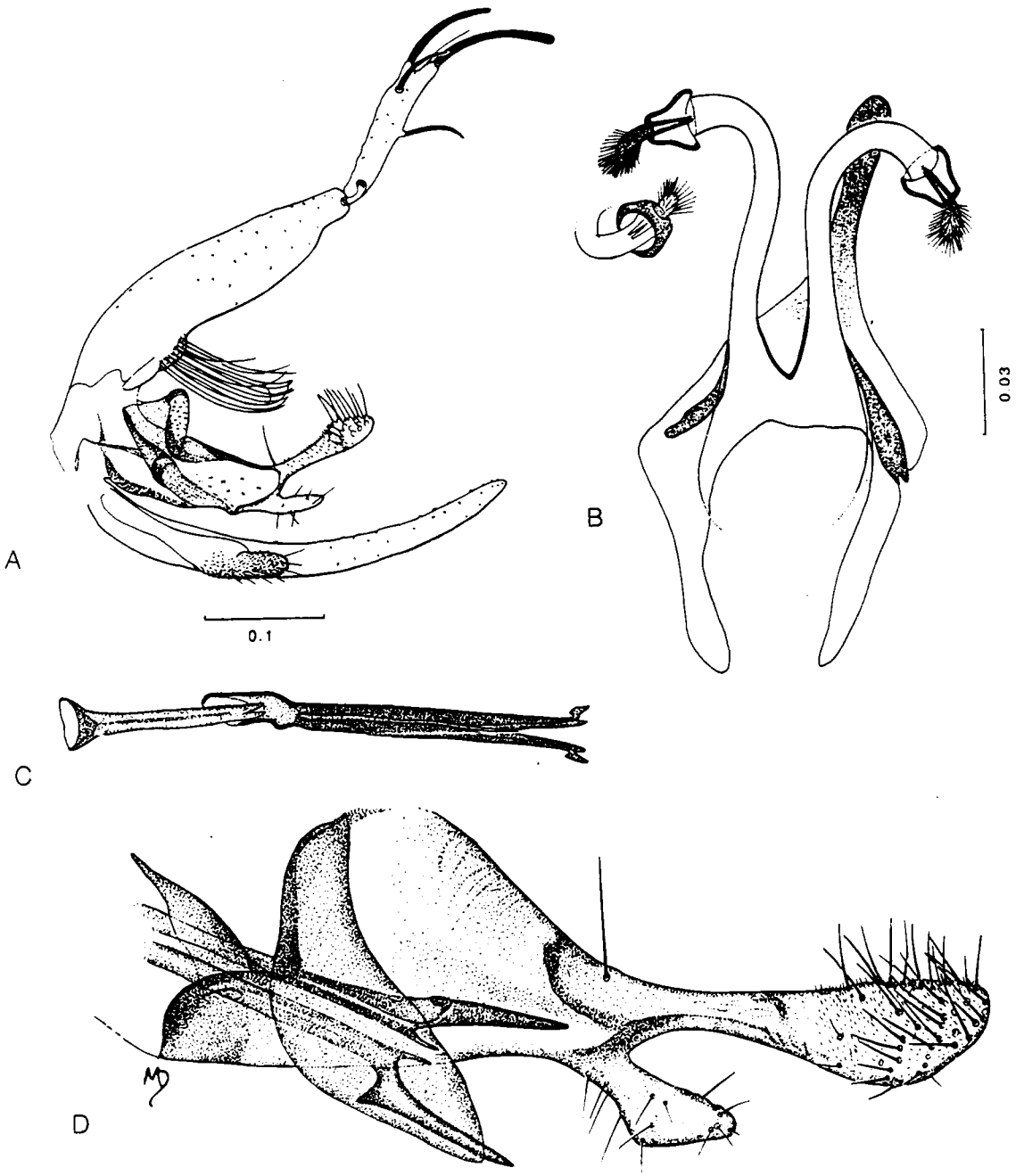



Plate 14-1

Lutzomyia carmelinoi. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments.

Lutzomyia lenti. D. Paramere & tips of genital filaments.

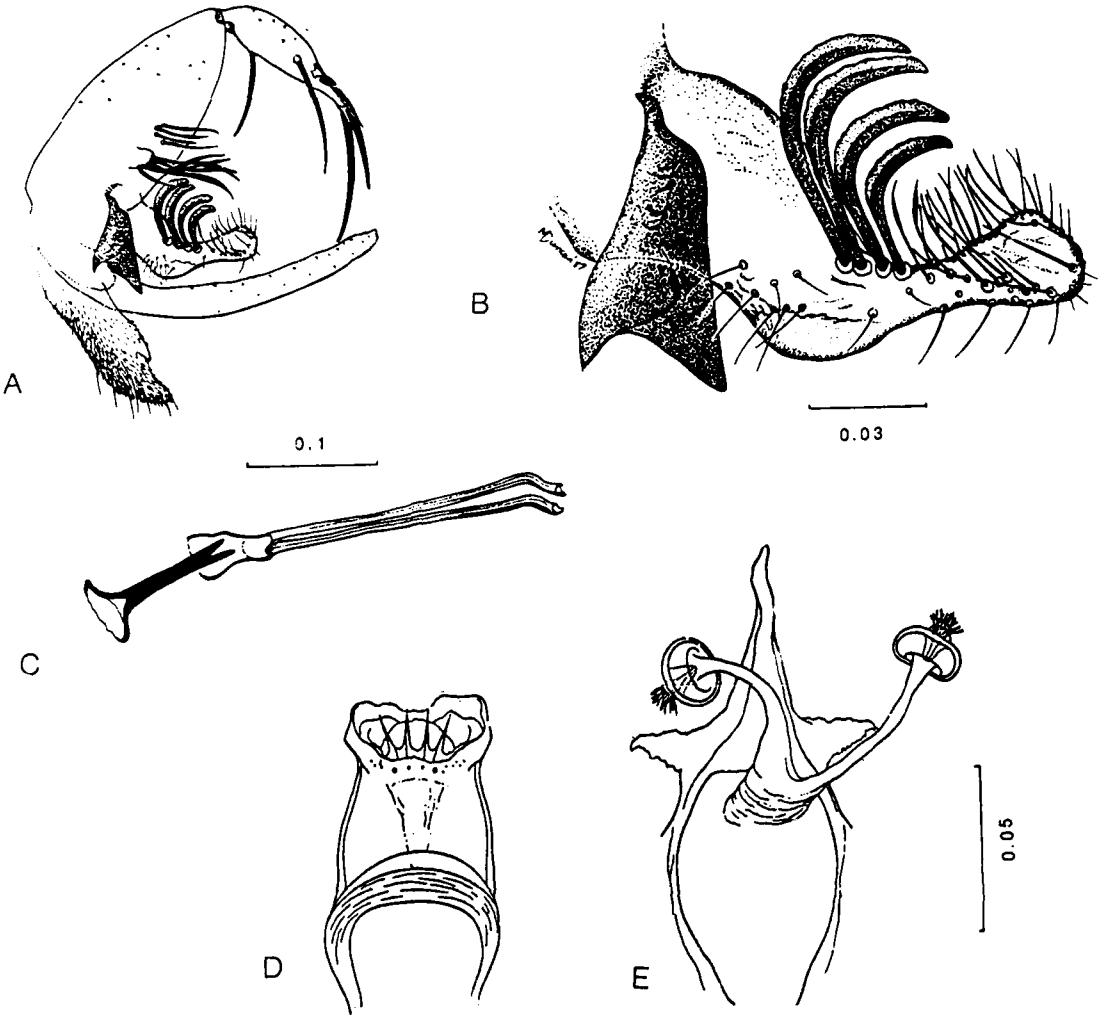



Plate 14-2

Lutzomyia edwardsi. A. Male terminalia; B. Paramere; C. Genital pump & filaments; D. Female cibarium; E. Spermathecae (figs. D & E from Mangabeira 1941a).

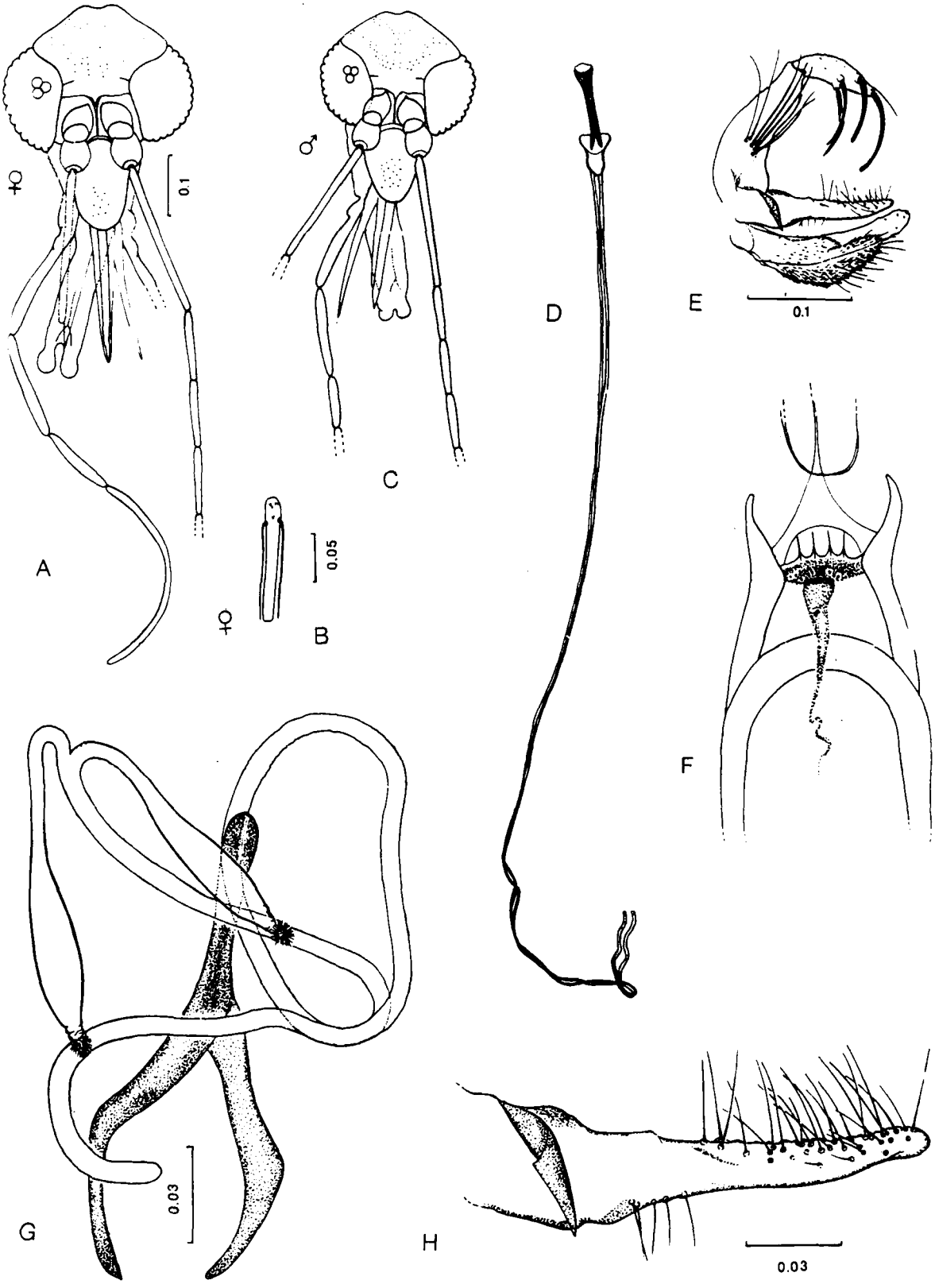



Plate 14-3

Lutzomyia pacae. A. Female head; B. Female flagellomere II; C. Male head; D. Genital pump & filaments; E. Male terminalia; F. Female cibarium; G. Spermathecae; H. Paramere.

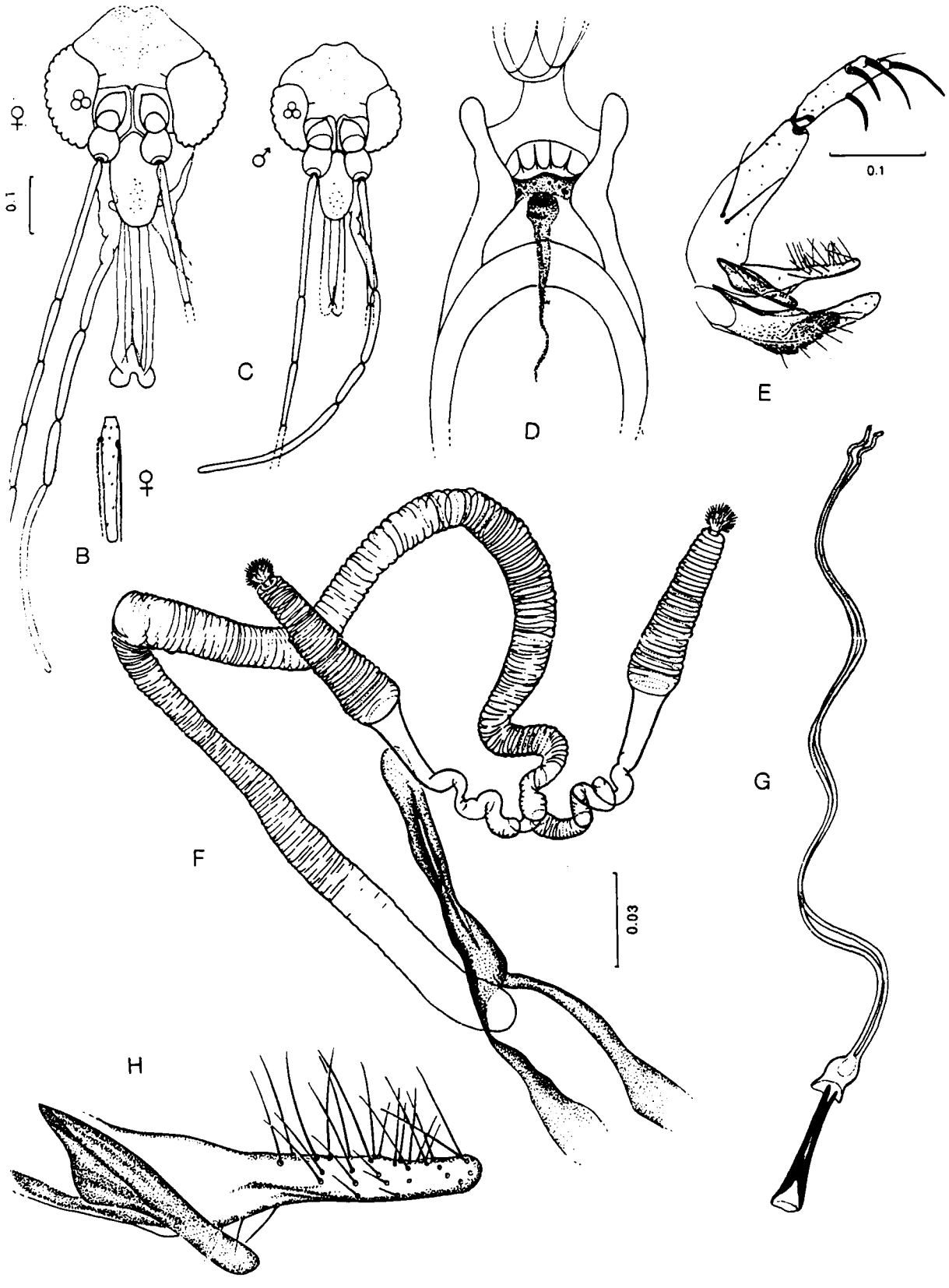



Plate 14-4

Lutzomyia gruta. A. Female head; B. Female flagellomere II; C. Male head; D. Female cibarium; E. Male terminalia; F. Spermathecae; G. Gential pump & filaments; H. Paramere.

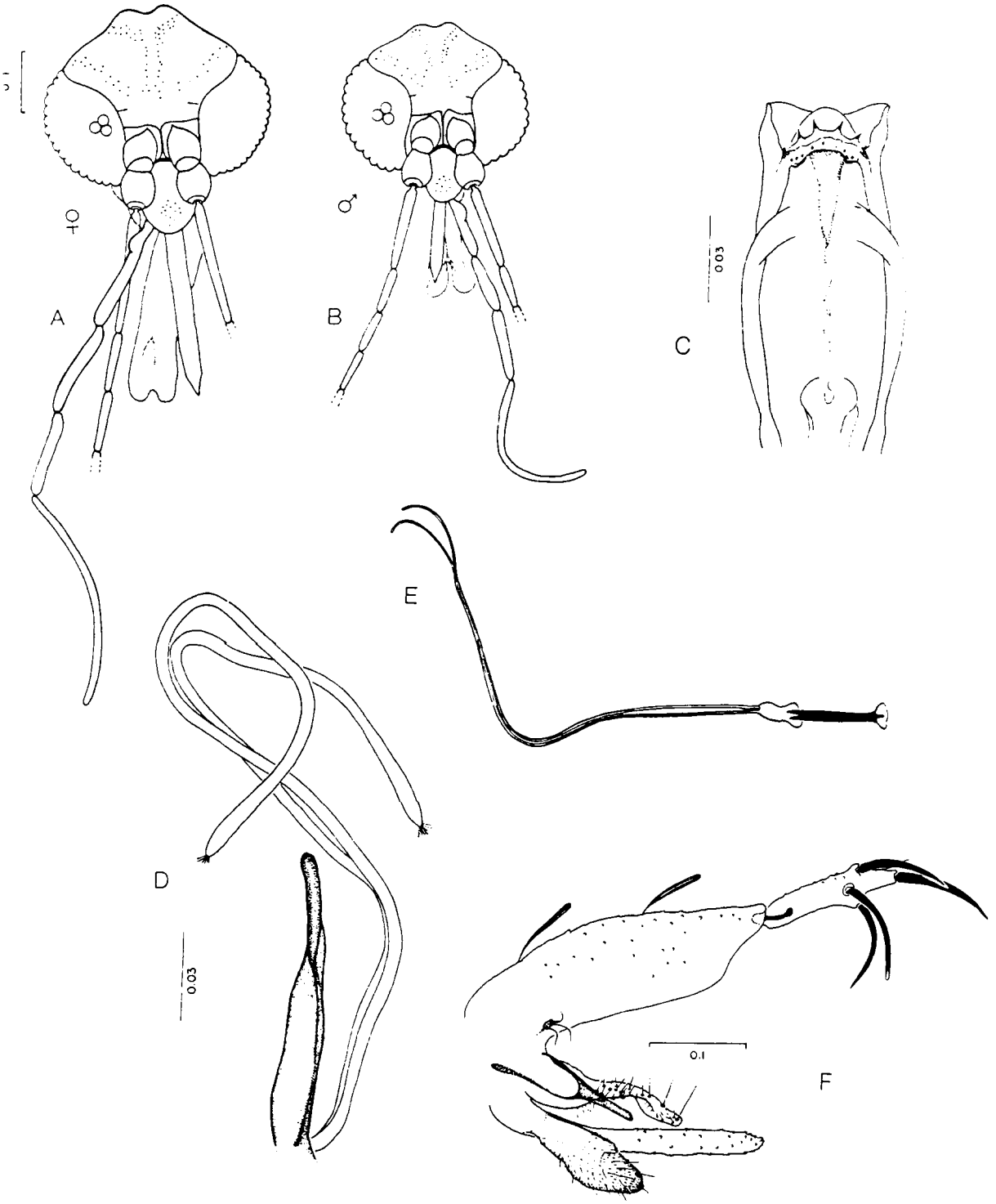



Plate 14-5

Lutzomyia migonei. A. Female head; B. Male head; C. Female cibarium; D. Spermathecae; E. Genital pump & filaments; F. Male terminalia (figs. C,D & F after Young 1979).

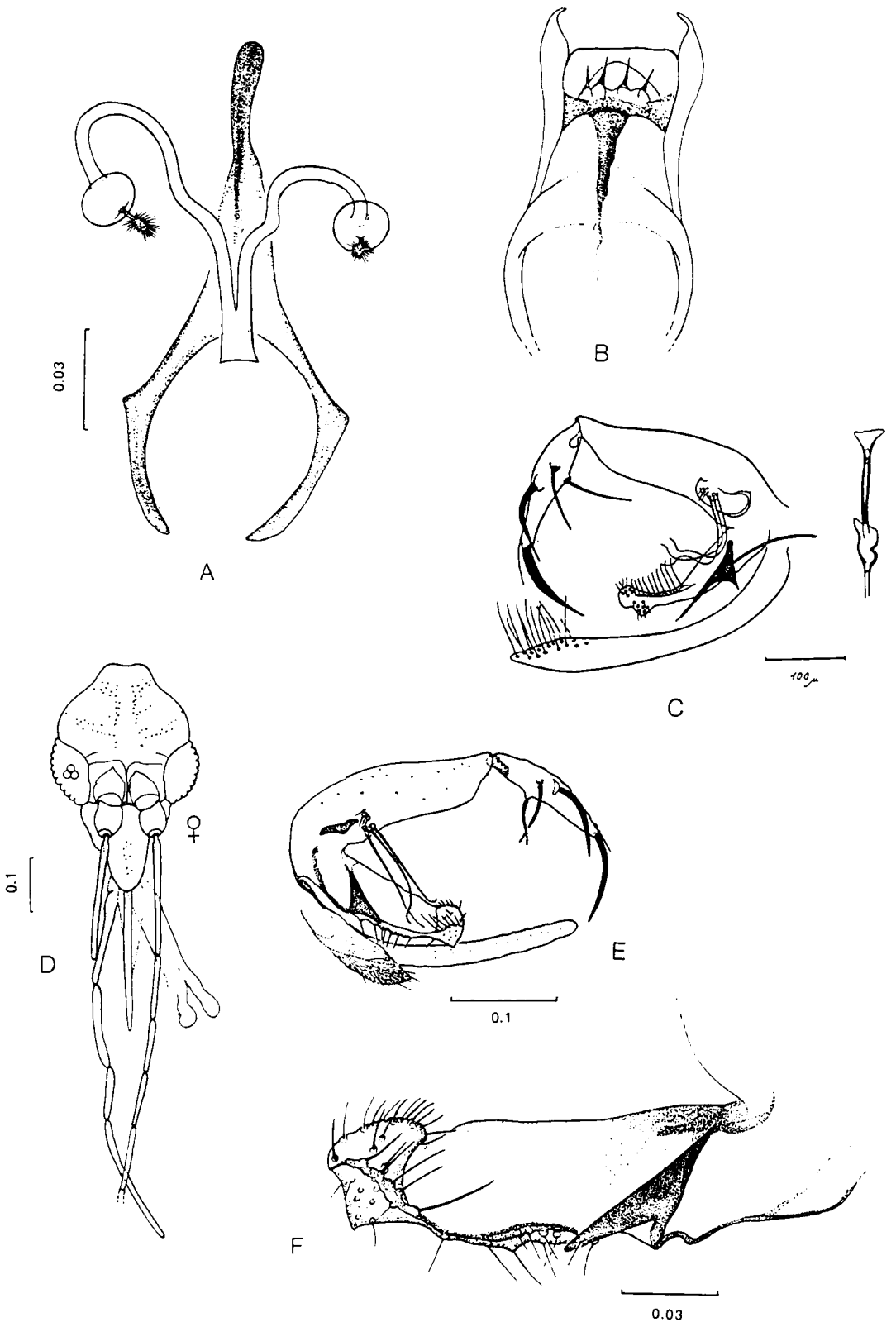



Plate 14-6

Lutzomyia sallesi. A. Spermathecae; B. Female cibarium; D. Female head; E. Male terminalia; F. Paramere.

Lutzomyia cortelezzii. C. Male terminalia & genital pump (after Theodor 1932).

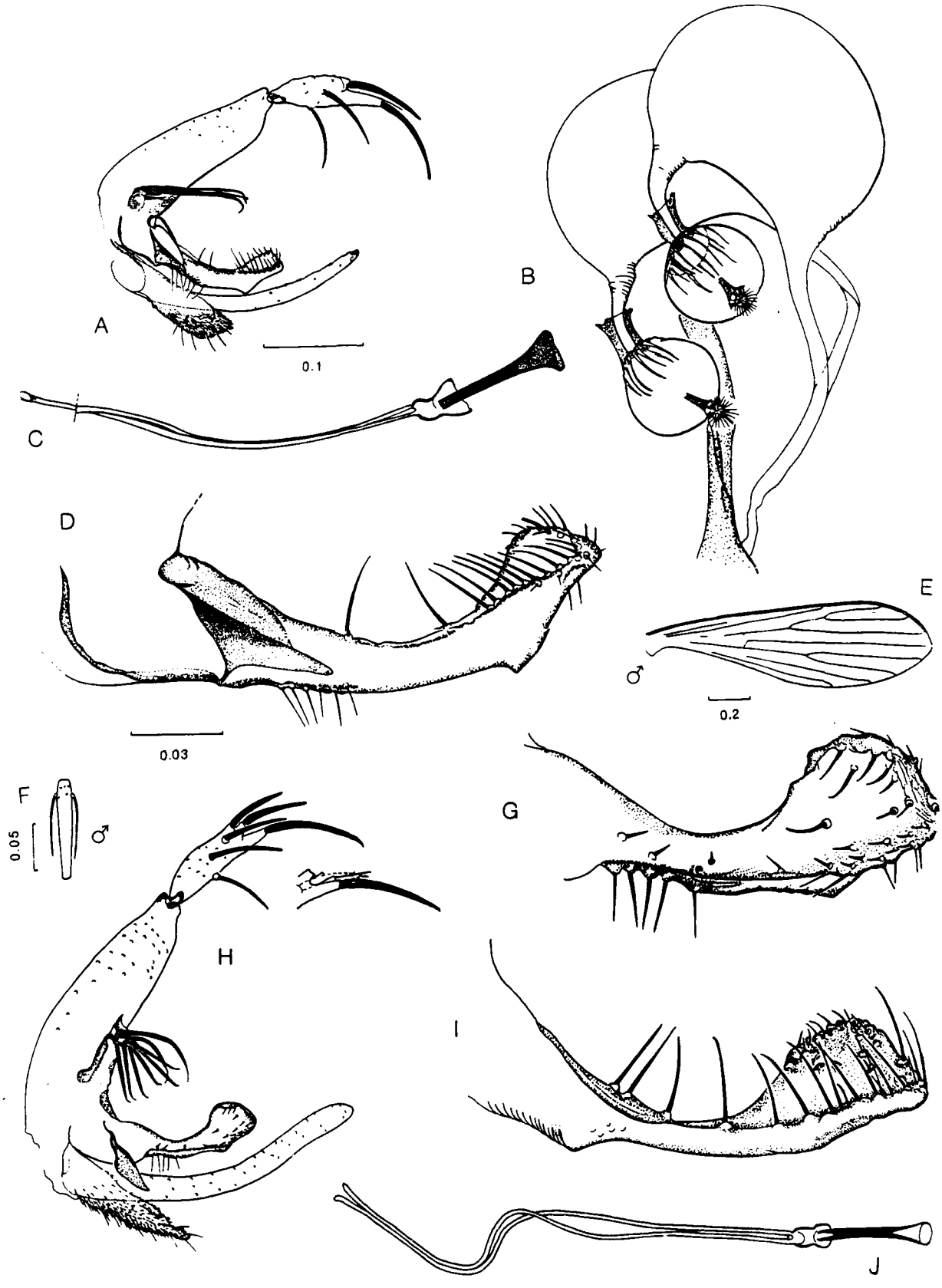



Plate 14-7

Lutzomyia tupynambai. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Paramere.

Lutzomyia bahiensis. E. Male wing; F. Male flagellomere II; G. Paramere; H. Male terminalia; I. Paramere; J. Genital pump & filaments.

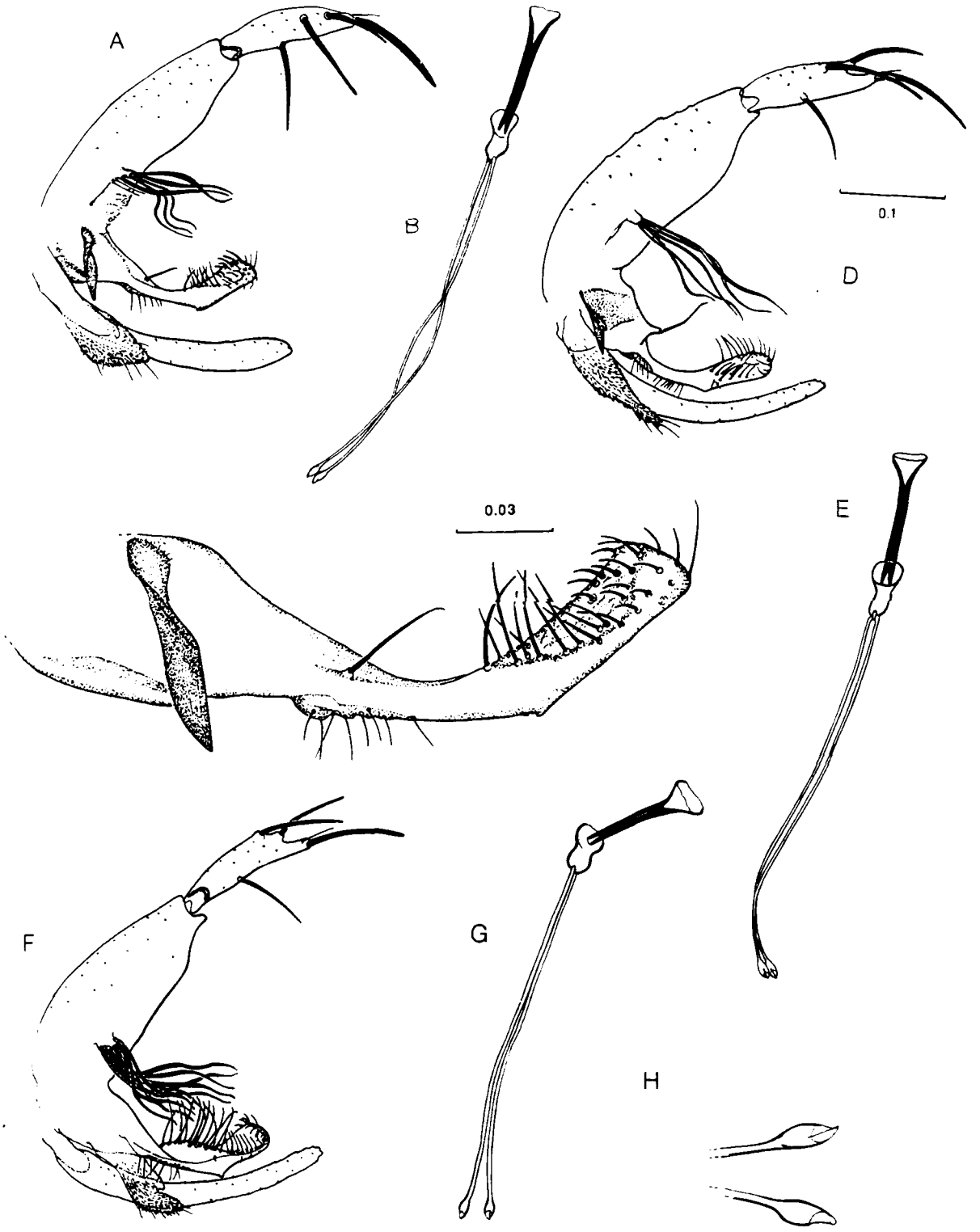



Plate 14-8

Lutzomyia petropolitana. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

Lutzomyia costalimai. D. Male terminalia; E. Genital pump & filaments.

Lutzomyia callipyga. F. Male terminalia; G. Genital pump & filaments; H. Tips of genital filaments.

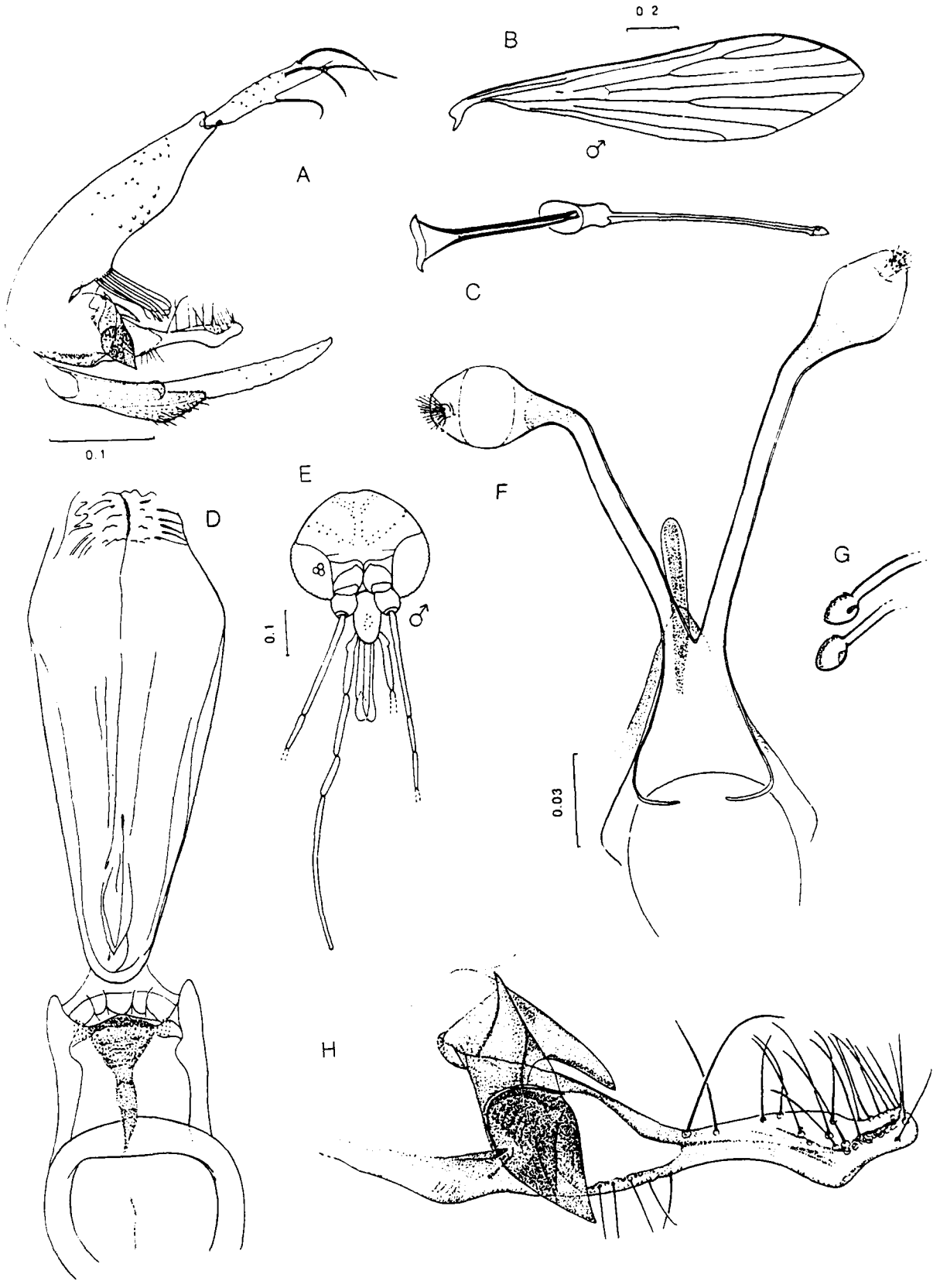



Plate 14-9

Lutzomyia williamsi. A. Male terminalia; B. Male wing; C. Gential pump & filaments; D. Female cibarium & pharynx; E. Male head; F. Spermathecae; G. Tips of genital filaments; H. Paramere.

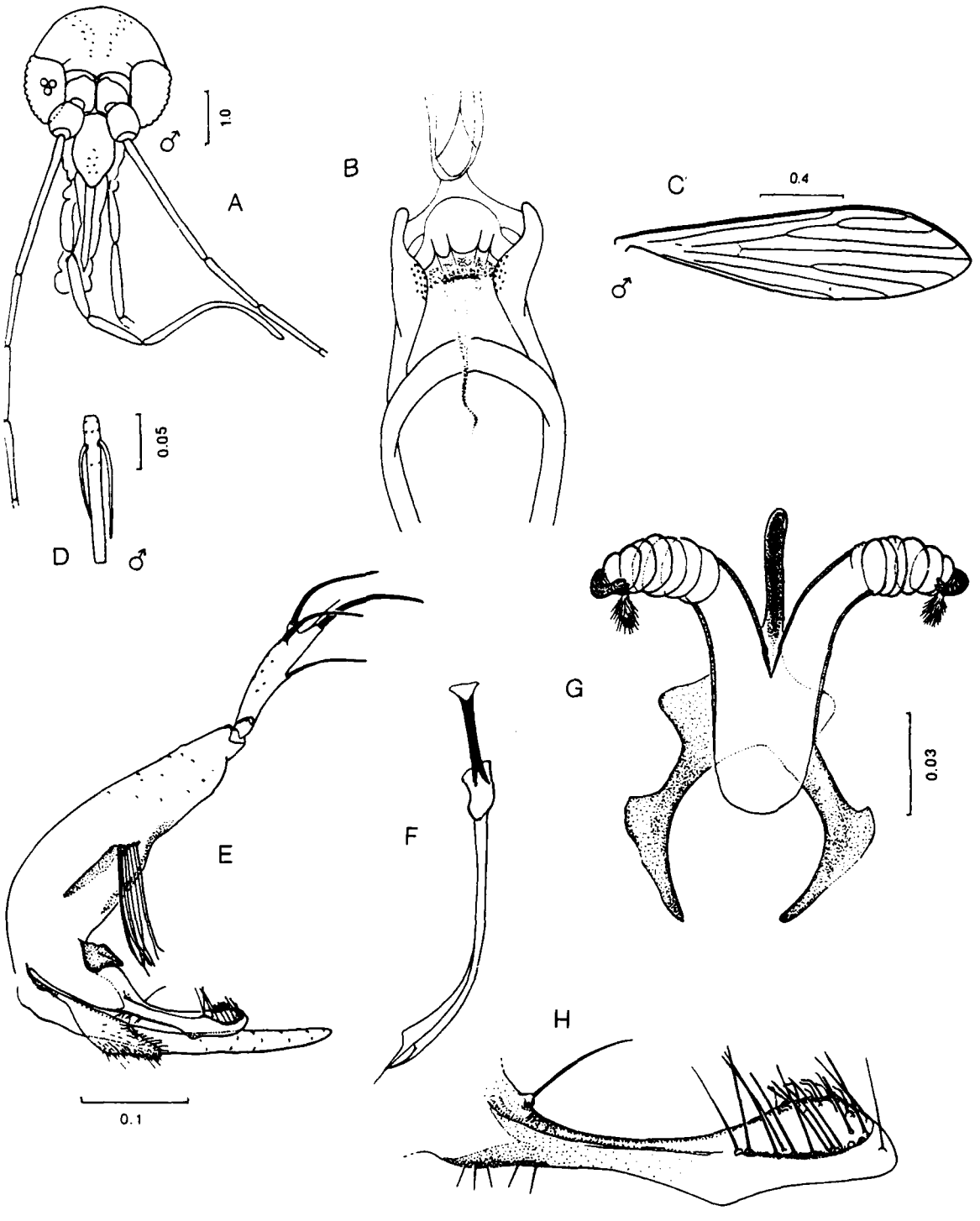



Plate 14-10

Lutzomyia termitophila. A. Male head; B. Female cibarium; C. Male wing; D. Male flagellomere II; E. Male terminalia; F. Genital pump & filaments; G. Spermathecae; H. Paramere.

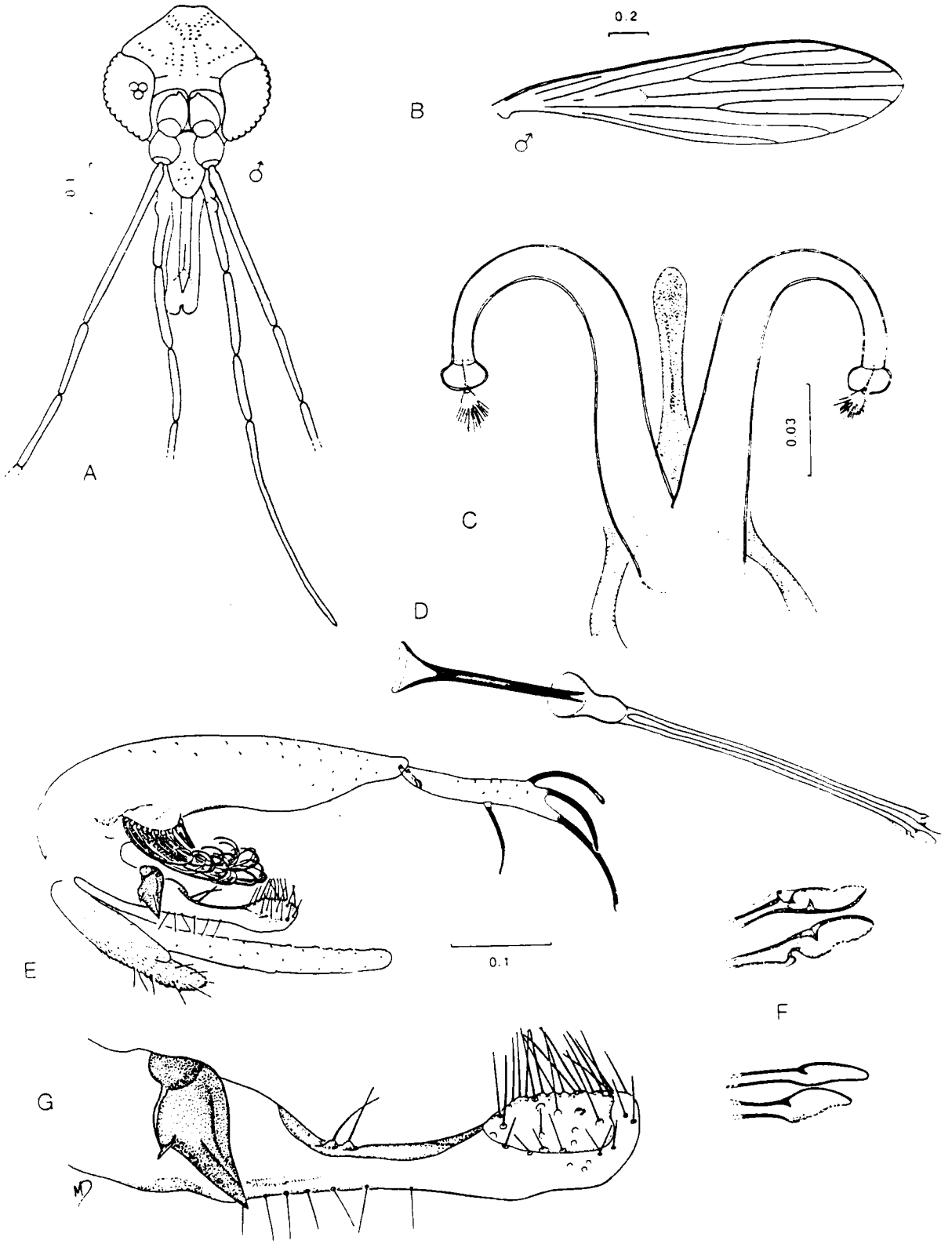



Plate 14-11

Lutzomyia sericea. A. Male head; B. Male wing; C. Spermathecae; D. Genital pump & filaments; E. Male terminalia; F. Tips of genital filaments; G. Paramere.

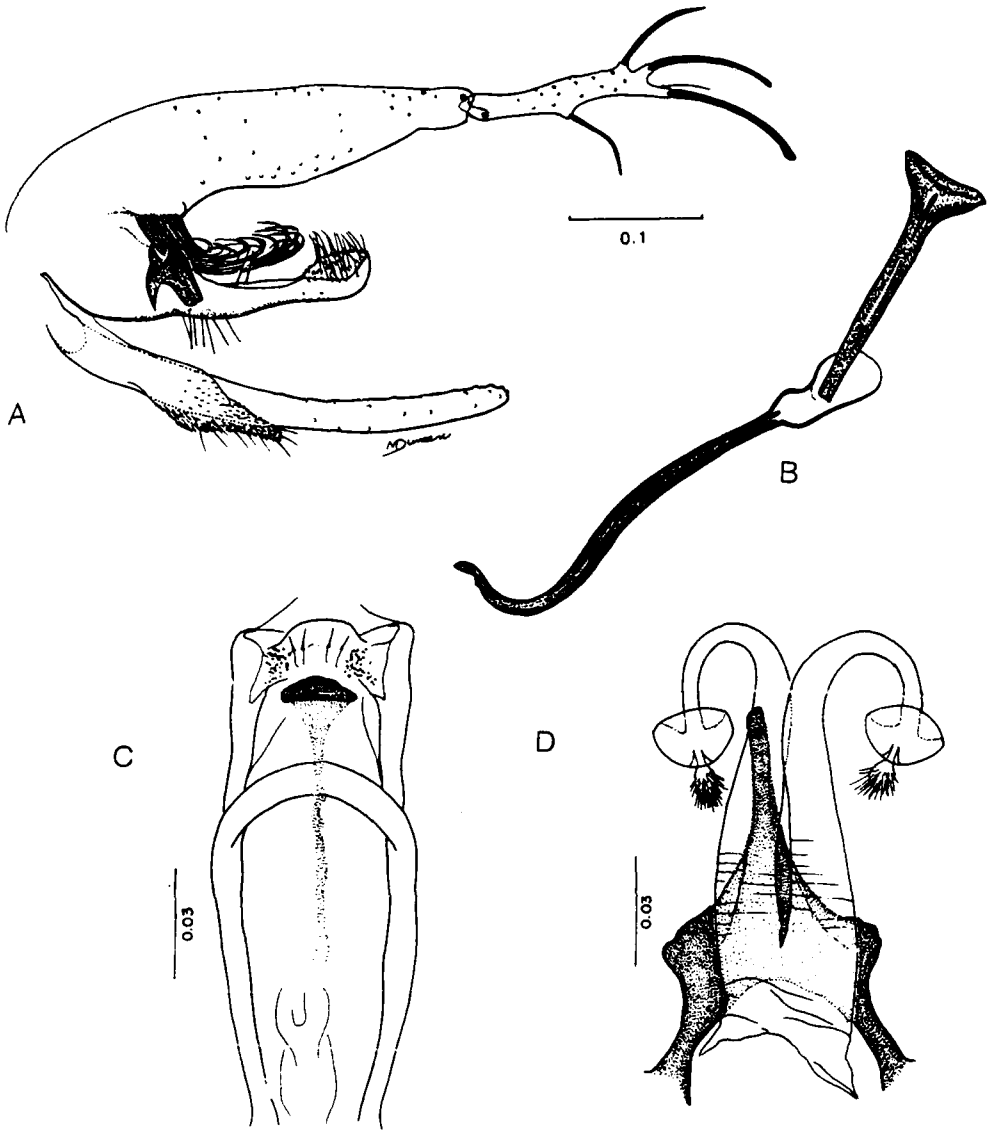



Plate 14-12

? Lutzomyia sp. of Baduel. A. Male terminalia; B. Genital pump & filaments; C. Female cibarium; D. Spermathecae (male figs. from Young & Morales 1987; female figs. from Young 1979).

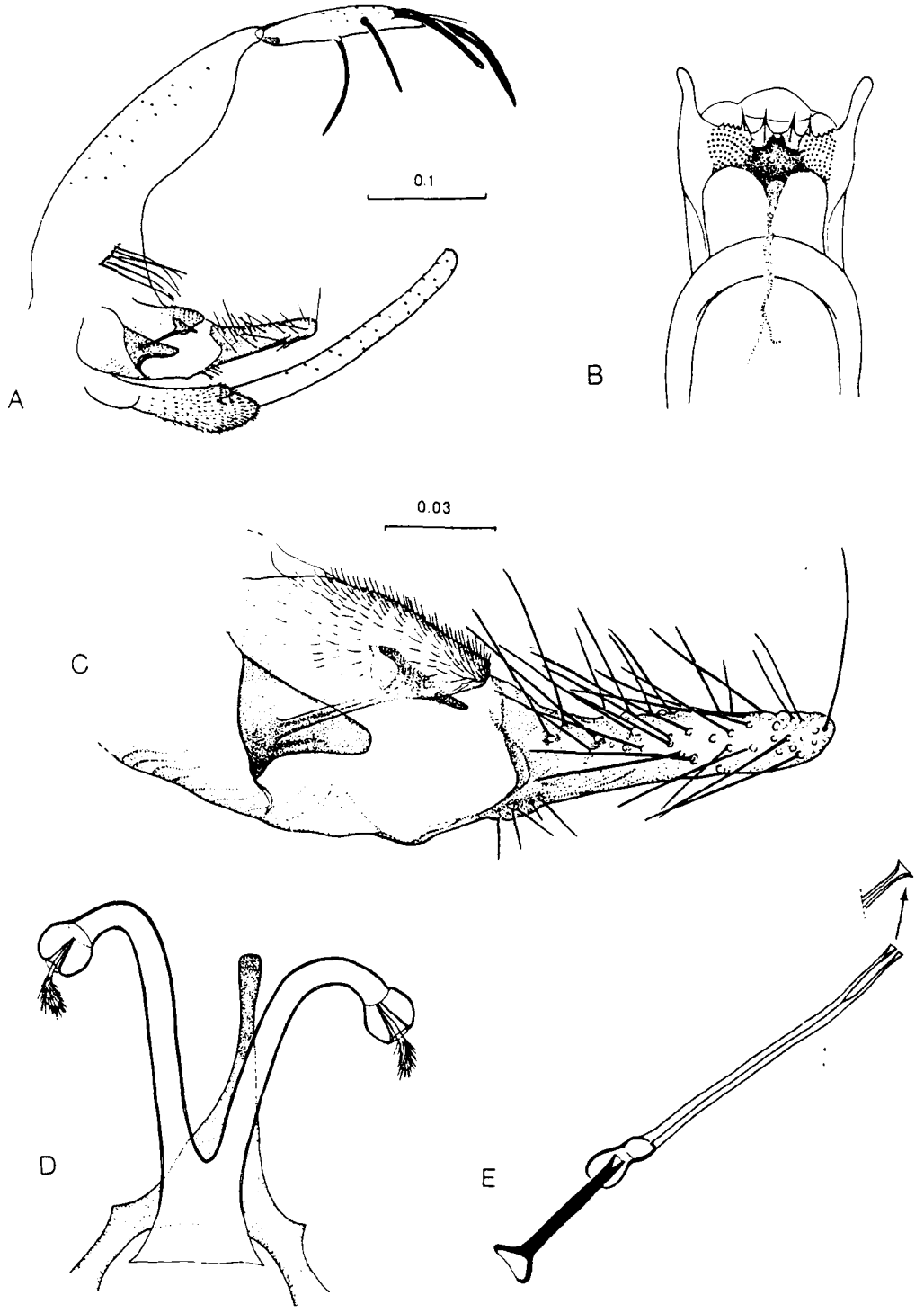



Plate 14-13

Lutzomyia evandroi. A. male terminalia; B. Female cibarium; C. Paramere; D. Spermathecae; E. Genital pump & filaments.

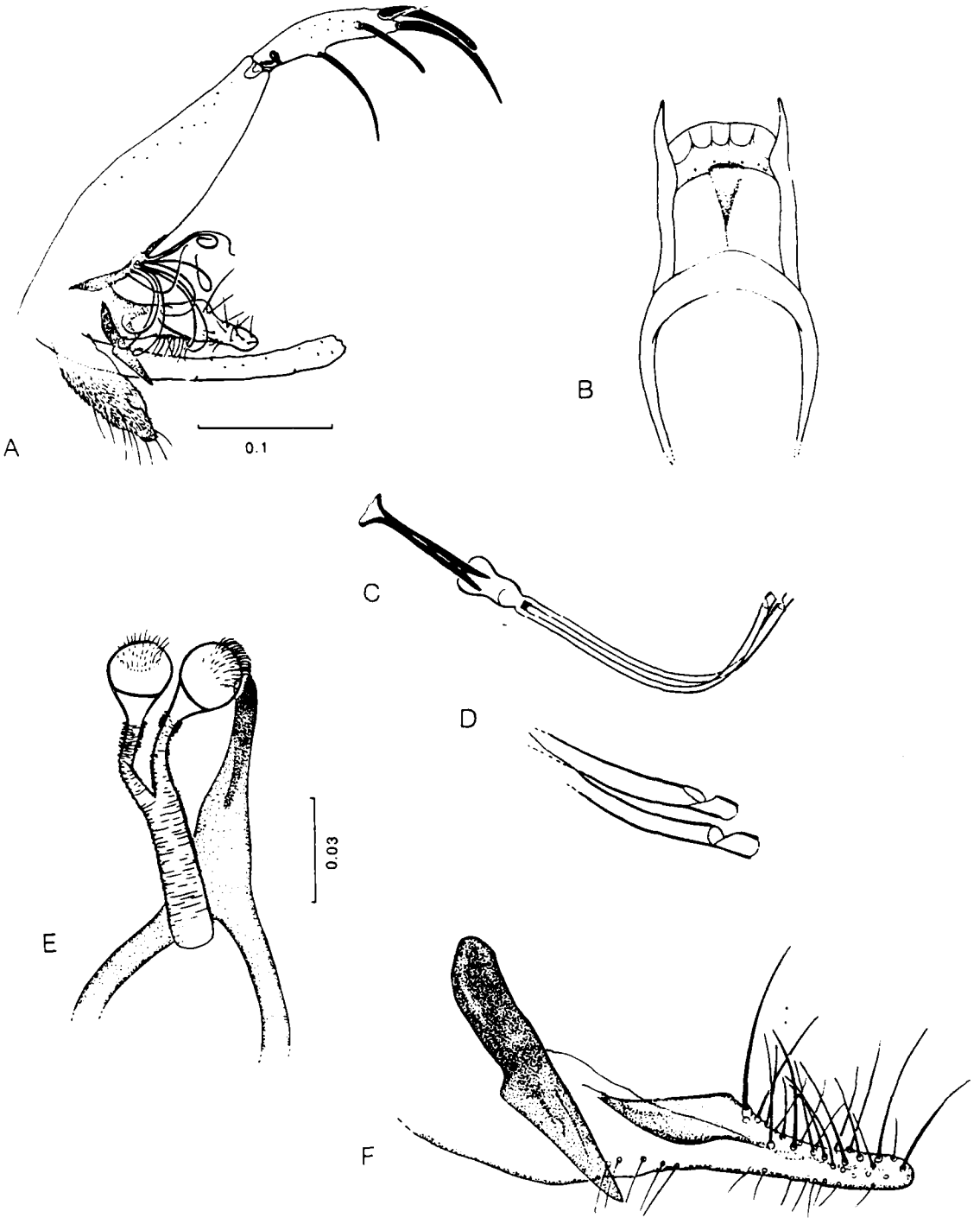



Plate 14-14

Lutzomyia firmatoi. A. Male terminalia; B. Female cibarium; C. Genital pump & filaments; D. Tips of genital filaments; E. Spermathecae; F. Paramere & aedeagus.

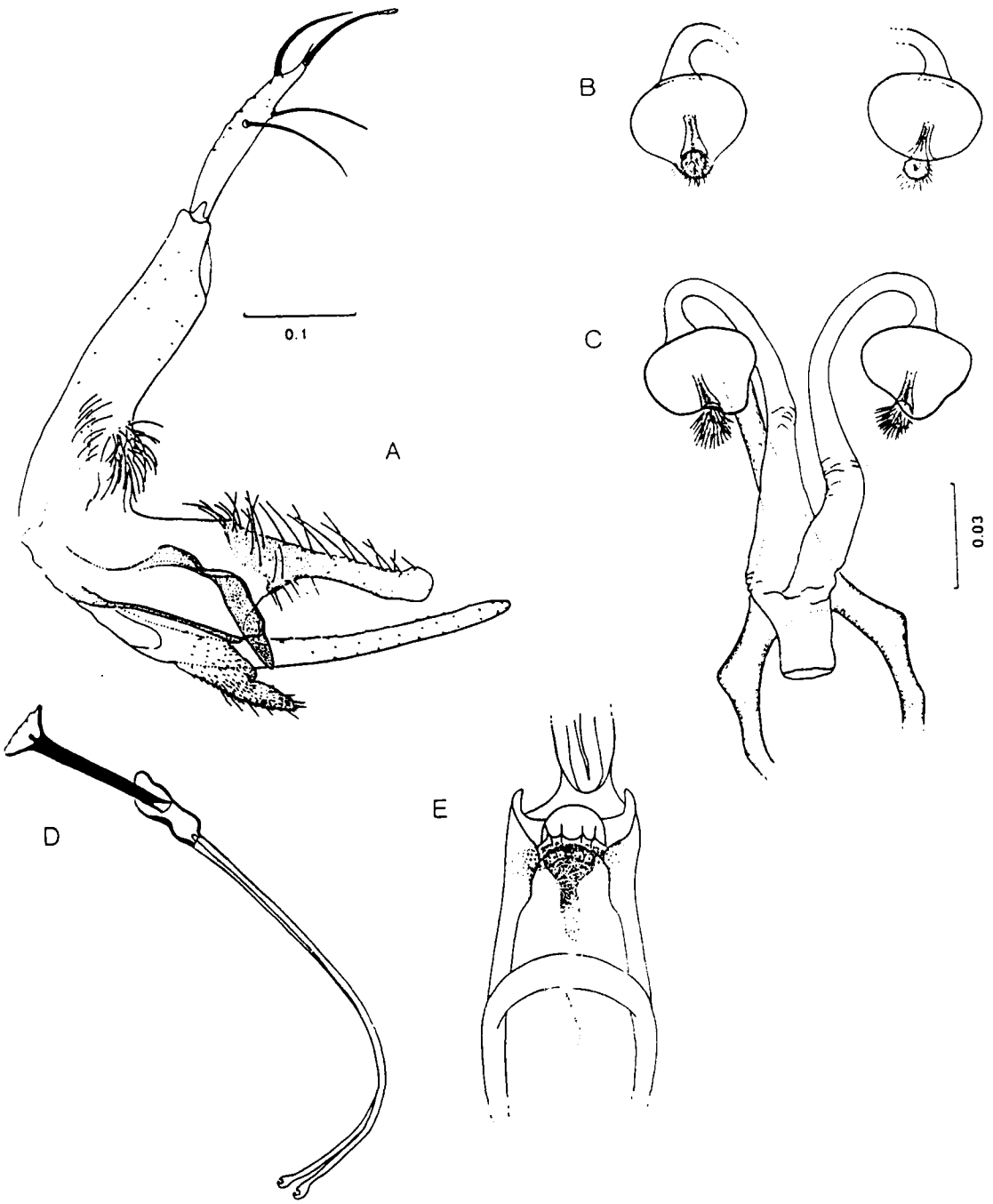



Plate 14-15

Lutzomyia baculus. A. Male terminalia; B. Spermathecae; C. Spermathecae; D. Genital pump & filaments; E. Female cibarium.

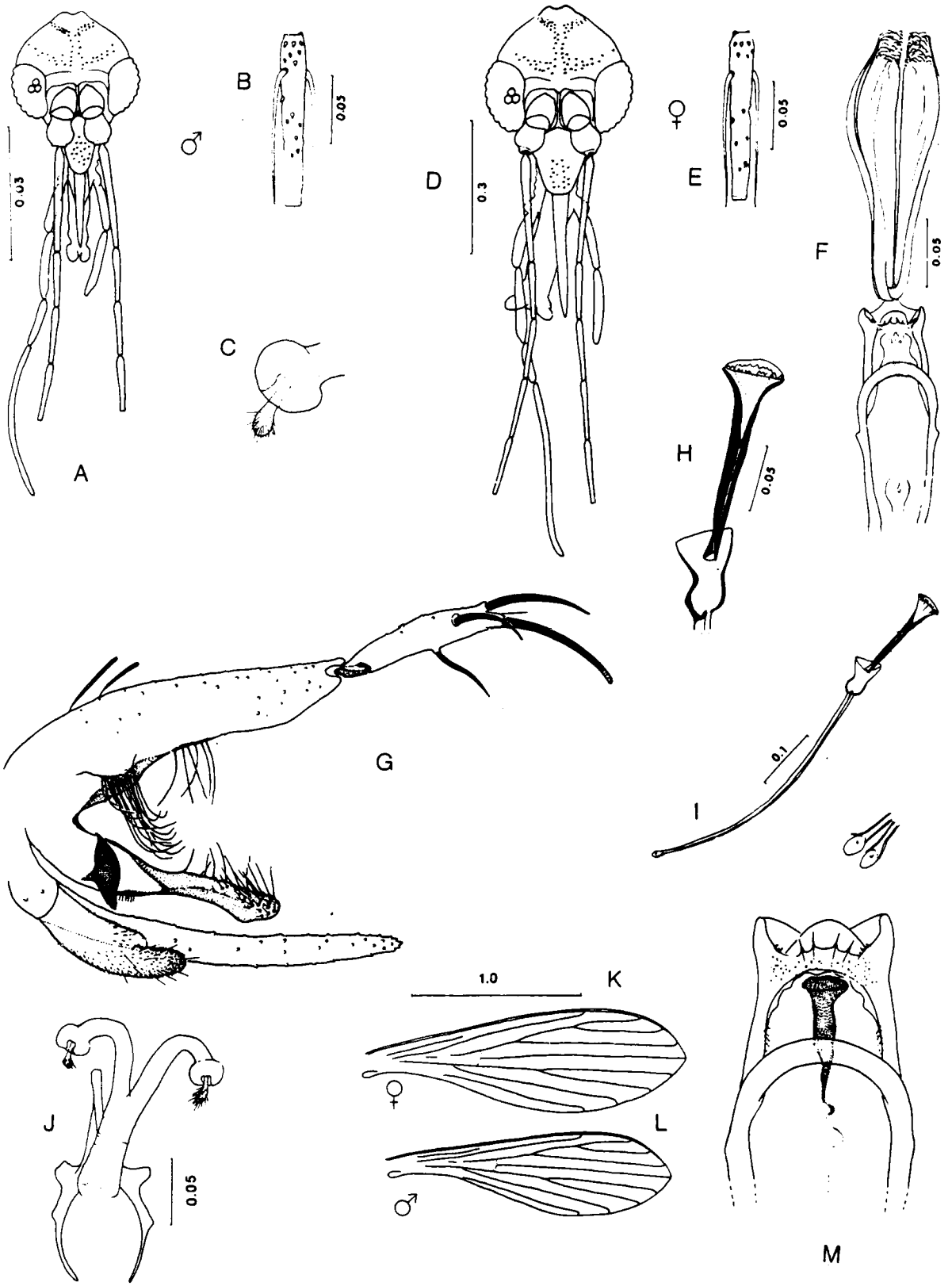



Plate 14-16

Lutzomyia dubitans. A. Male head; B. Male flagellomere II; C. Spermatheca; D. Female head; E. Female flagellomere II; F. Female cibarium & pharynx; G. Male terminalia; H. Genital pump; I. Genital pump & filaments; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium (from Young 1979).

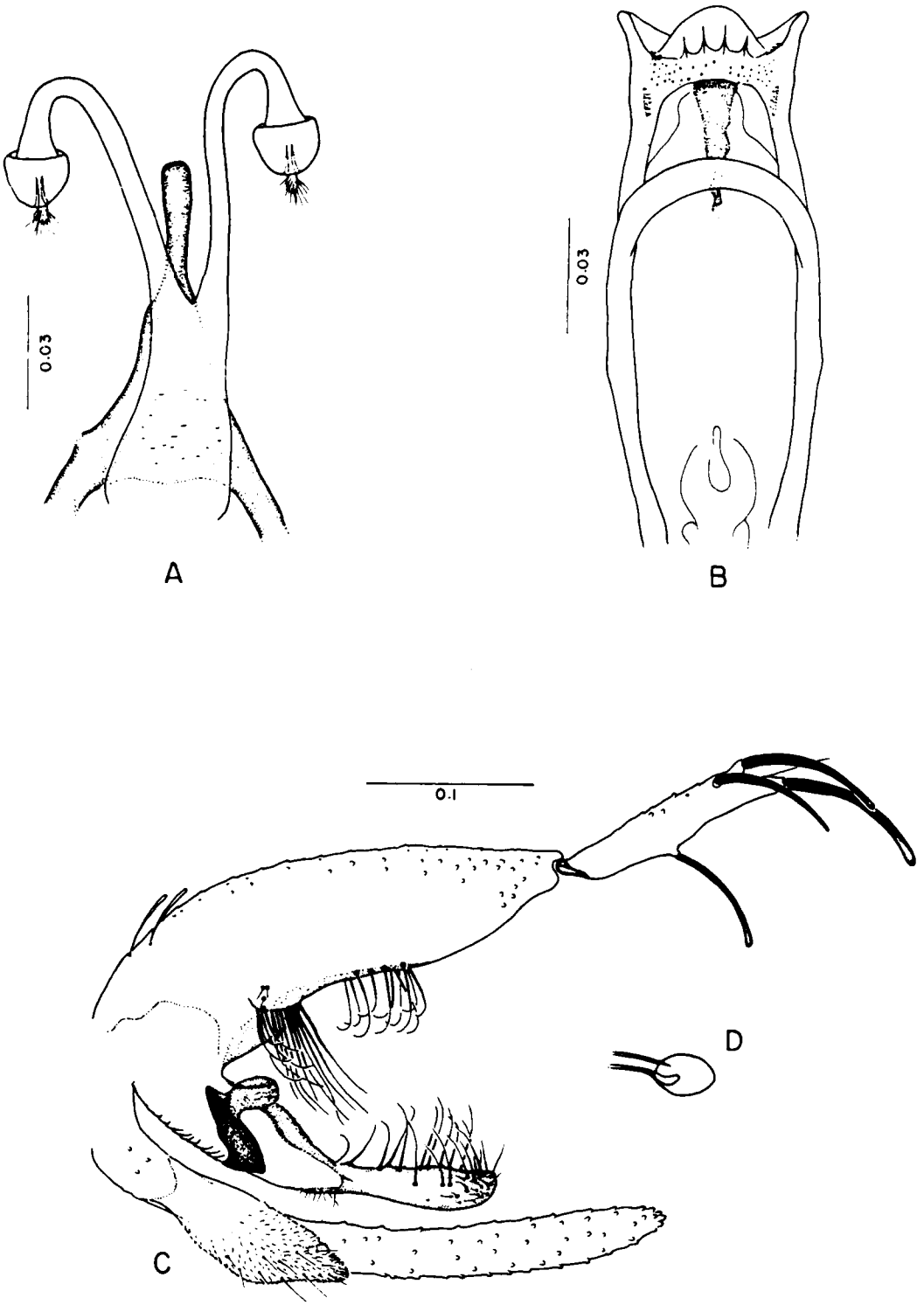
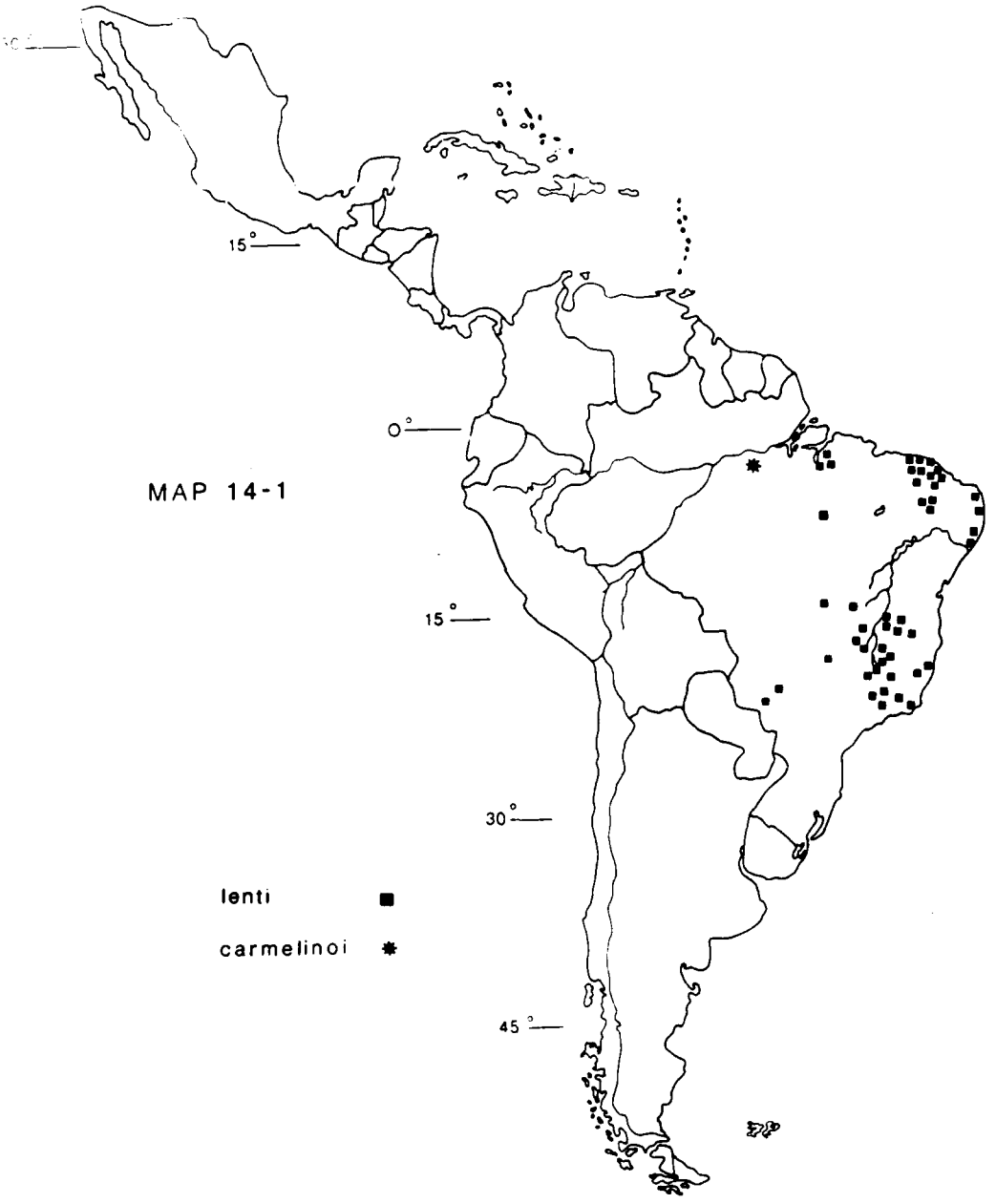



Plate 14-17

Lutzomyia walkeri. A. Spermathecae; B. Female cibarium; C. Male terminalia; D. Tip of genital filament.




MAP 14-1



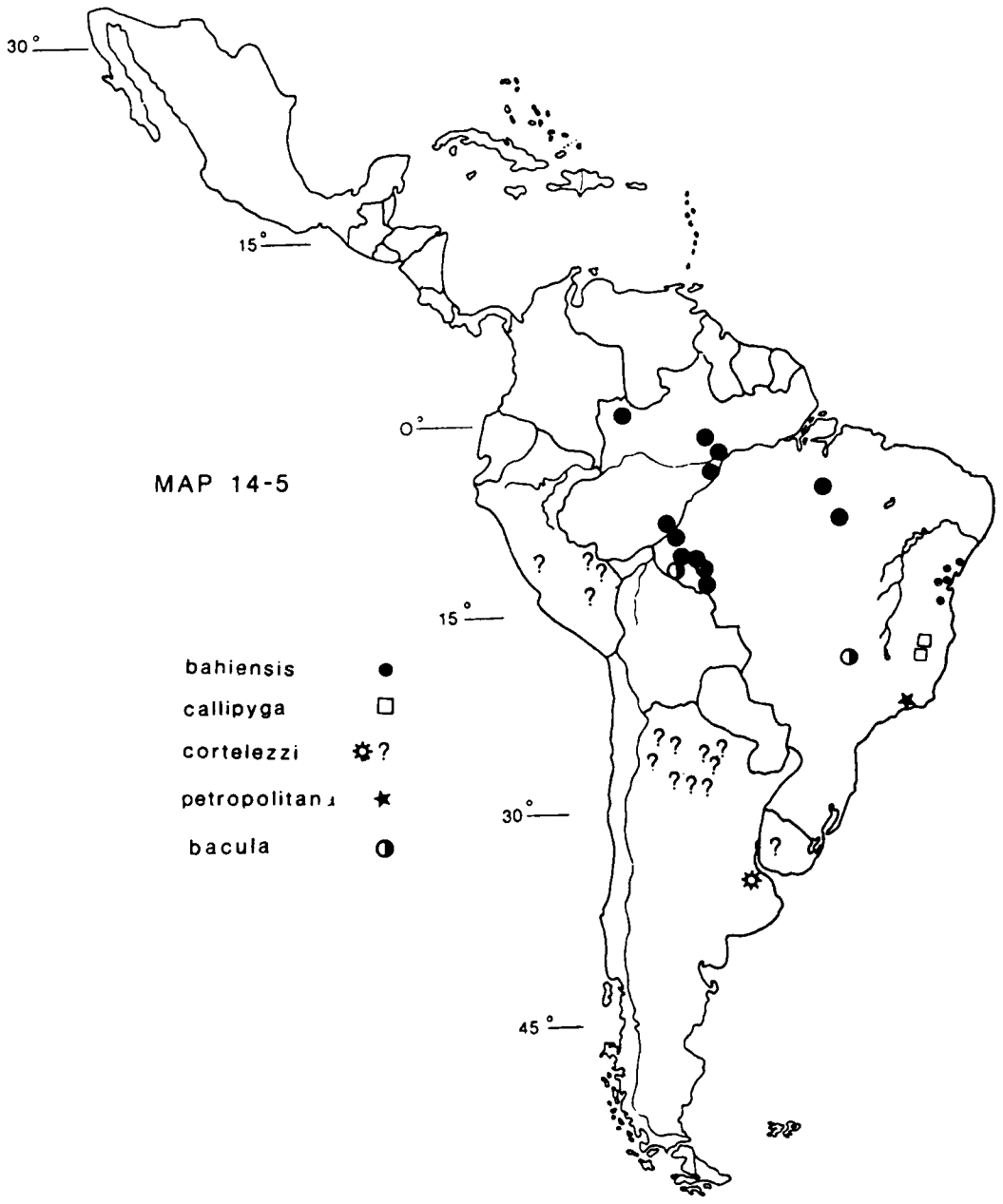

MAP 14-2




MAP 14-3




MAP 14-4


30°
15°
0°
15°
30°
45°
MAP 14-5
bahiensis
callipyga
cortelezzi
petropolitana
bacula




MAP 14-6



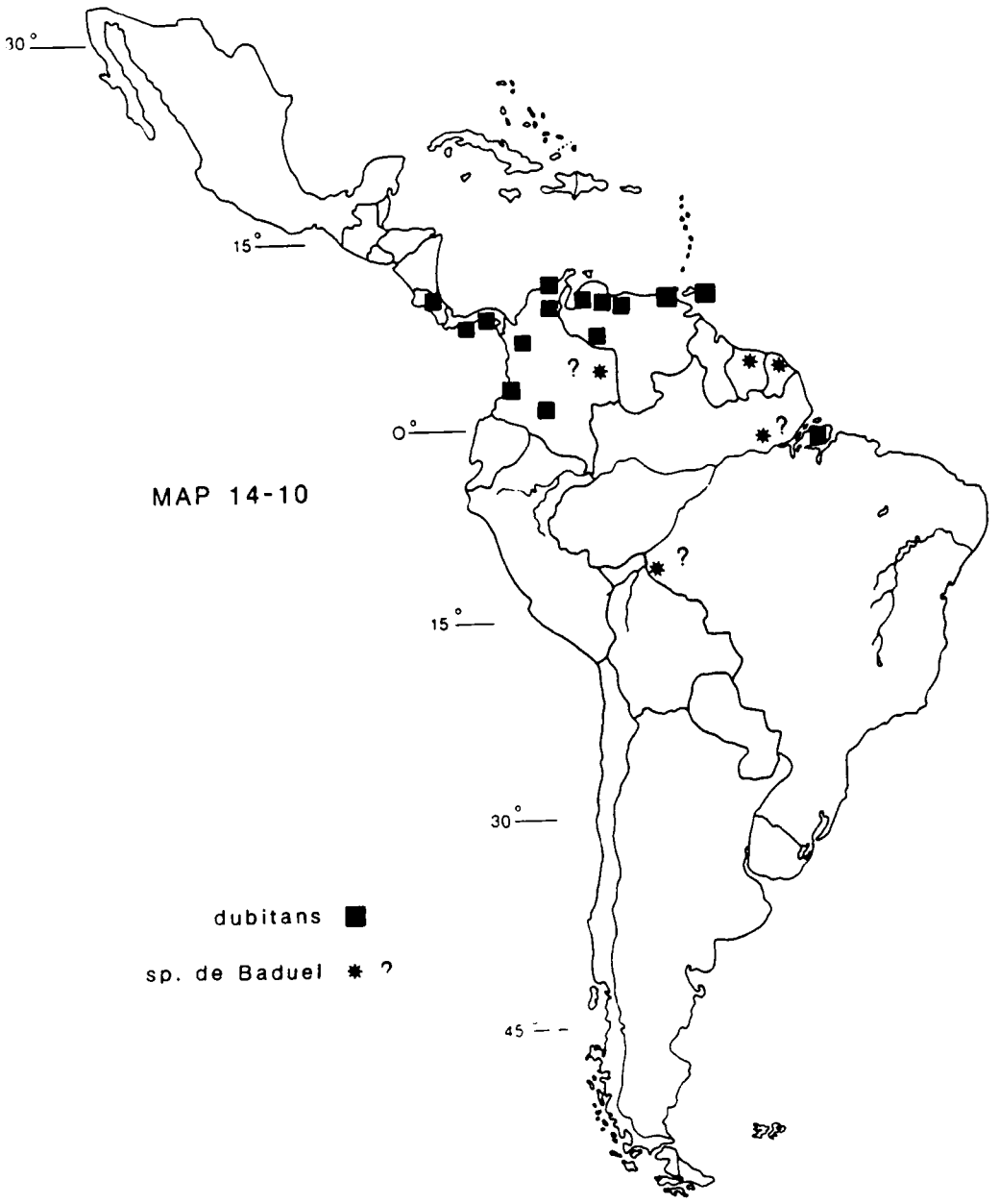

MAP 14-7




MAP 14-8




MAP 14-9


30°
15°
0°
15°
30°
45°
?
?
?
?
MAP 14-10
dubitans
sp. de Baduel ? ?




MAP 14-11

evandroi ■




MAP 14-12

firmatoi •




MAP 14-13

## 15. Lutzomyia Species Group Verrucarum

Lutzomyia subgenus Coromyia Barretto 1962: 97. Martins et al. 1978: 88 (in part).

Phlebotomus subgenus Pifanomyia Ortiz & Scorza 1963: 344 (type species: P. serranus Damasceno & Causey by orig. designation).

Lutzomyia species group verrucarum Theodor 1965: 183 (defined). Lewis et al. 1977: 325. Martins et al. 1978: 124 (in part, defined).

Lutzomyia subgenus Lutzomyia: Forattini 1973: 212.

Identification. Coloration pale to dark. Antennal ascoids simple. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 horizontal teeth & 1-2 transverse rows of vertical teeth; arch nearly complete or complete; pigment patch conspicuous. Pharynx unarmed. Spermathecae variable, usually sac-like with incomplete or complete annulations or striations. ♂ genitalia. Coxite with or without persistent setae (only L. nevesi). Style with 3 or 4 large spines; subterminal seta present or absent. Paramere simple, without arms or extensions.

Males in the verrucarum group with 3 major spines on each style are often placed in the series serrana; those with 4 such spines are included in the verrucarum series (Theodor 1965). Within the latter series, there is a complex of species, the males of which have an isolated basal spine on each style. We informally name this group the townsendi complex. The included species have evolved, in mountainous areas, mostly the Andes. The females are morphologically inseparable.

Medical Importance. Considerable; females of L. verrucarum may transmit Bartonella and Leishmania in Peru. Other species in Venezuela, Colombia and Costa Rica are suspected vectors of Leishmania.

Key to the Males of the Species Group Verrucarum

1. Style bearing 2 or 3 strong spines & small subterminal seta (serrana complex). ..... 2

   Style bearing 4 strong spines; subterminal seta present or absent (verrucarum complex). ..... 7

2. Style bearing 3 strong spines. Scutum pale. Coxite tuft of 9 or more setae (West Indies). ..... 3

   Style bearing 2 strong spines, 1 thin basal spine & subterminal seta. Scutum darker than pleura. Coxite tuft of 8 or fewer setae (continental distribution). ..... 4

3. Coxite with 20+ five setae implanted on raised, circular base. Genital filament tips expanded & modified (Hispaniola). ..... L. christophei (Pl. 15-1)

   Coxite with fewer setae, not borne on circular base. Genital filament tips not expanded or modified (Cuba & other W.I. islands). ..... L. orestes (Pl. 15-1)

4. Coxite with basal setae implanted in a single row. ..... 5

   Coxite with basal setae not implanted in a single row. ..... 6

5. Coxite with upturned, curved basal setae. ..... L. serrana (Pl. 15-2)

   Coxite with straight, more slender basal setae.... L. oresbia (Pl. 15-3)

6. Coxite with ca. 7 basal setae, most or all markedly recurved apically. ..... L. odax (Pl. 15-4)

   Coxite with 3-4 setae with straight, slender tips. ..... L. ottolinai (Pl. 15-5)

7. Style with isolated basal spine (townsendi complex). ..... 8

   Style with paired basal spines. ..... 15

8. Style with terminal spine relatively thick & crooked. ..... L. spinicrassa (Pl. 15-6)

   Style with terminal spine more slender, not crooked, but gently curved. ..... 9

9. Coxite tuft of 15 or fewer setae, all more or less straight. Paramere setation as shown. ..... ..... Lutzomyia (verrucarum group) n.sp. #1 (Pl. 15-7)

   Coxite tuft of 20 or more setae, many distinctly curved upwards. Paramere otherwise. ..... 10

10. Paramere with 7 or more long thin subterminal setae in addition to group of shorter, thicker setae. ..... ..... Lutzomyia (verrucarum group) n.sp. #2 (Pl. 15-8)

    Paramere without such a group of long setae. ..... 11

11. Coxite with longest setae of basal tuft reaching or surpassing apex of paramere. ..... 12

Coxite with all setae of basal tuft ending well before apex of paramere. ..... 13

12. Paramere with lateral median group of ca. 6 short, thin setae; distal third of structure with row of ca. 12 spine-like dorsal setae & with relatively thin setae at apex. ..... L. longiflocosa (Pl. 15-9)

Paramere with lateral median group of 4-6 relatively long, stronger setae; distal third of structure with row of hair-like setae & with ca. 9 thicker dorsal setae at apex. ..... L. amilcari (Pl. 15-10)

13. Paramere with some dorsal setae at middle third of structure. ..... L. sauroida (Pl. 15-11)

L. townsendi (Pl. 15-12)

Paramere without dorsal setae at middle third of structure. ..... 14

14. Paramere with row of ca. 8 dorsal setae, subequal in size, at distal third of structure; 3-4 similar setae & smaller hairs near end of paramere. ..... L. quasitownsendi (Pl. 15-13)

Paramere with a row of ca. 8 dorsal setae, proximal setae larger than others, at distal third of structure; only smaller hairs near end of paramere. ..... L. youngi (Pl. 15-14)

15. Style with basal paired spines inserted on well defined, rather long tubercles. Genital filament tips inflated. ..... 16

Style with basal paired spines inserted directly on style, not implanted on tubercles. Genital filament tips inflated or not. .... 18

16. Coxite with most setae of basal tuft as wide as that of median portion of genital filament. Style lacking small subterminal seta. Paramere with ventral heel. ..... L. moralesi (Pl. 15-15)
Coxite with tuft or thin setae, their width much less than that of genital filaments. Style with small subterminal seta. Paramere without ventral heel. ..... 17

17. Style with shorter basal spine expanded distally, appearing truncate as shown. ..... L. andina (Pl. 15-16)
Style with shorter basal spine without such modification. ..... L. aulari (Pl. 15-17)

18. Paramere with dorsal setae restricted to distal third of structure; 1 isolated dorsal seta may also be present at basal fourth of paramere. ..... 19
Paramere with dorsal setae covering more of structure. ..... 21

19. Coxite tuft of fewer than 7 setae. Flagellomere I and labrum subequal in length. ..... L. ovallesi (Pl. 15-18)
Coxite tuft of 10 or more setae. Flagellomere I considerably longer than labrum. ..... 20

20. Paramere strongly clubbed; lacking small isolated dorsal seta near base. Coxite without subapical group of ventral setae. ..... L. columbiana (Pl. 15-19)

Paramere otherwise, less clubbed but with small dorsal seta near base. Coxite with group of ventral setae. ... L. verrucarum (Pl. 15-20)

21. Paramere slightly clubbed subapically & ending in a slender finger-like projection. Coxite with tuft of 15 or more setae. ..... L. disiuncta (Pl. 15-21)

Paramere not clubbed, distal half nearly uniform in width or becoming more slender towards tip. Coxite with tuft of 0 to 8 setae. ..... 22

22. Coxite lacking persistent setae. ..... L. nevesi (Pl. 15-22)

Coxite with basal group of setae. ..... 23

23. Genital filaments longer than 4X length of pump... L. evansi (Pl. 15-23)

Genital filaments shorter than 4X pump. ..... L. nuneztovari (Pl. 15-24)

## Key to the Females of the Species Group Verrucarum

1. Scutum dusky or pale, not contrasting with pleura (West Indies excluding Trinidad). ..... 2

Scutum darker than pleura (continental including Trinidad). ..... 3

2. Spermathecae as shown; common sperm duct wide, maximum width greater than 3X width of genital fork stem (Hispaniola). ..... L. christophei (Pl. 15-1)

Spermathecae otherwise; common sperm duct slender, maximum width subequal to width of genital fork stem (Cuba, Cayman Islands). ..... L. orestes (Pl. 15-1)

3. Flagellomere I subequal to or much longer than labrum. ..... 4
   Flagellomere I shorter than labrum. ..... 7

4. Spermathecae with terminal knob about as long as wide, not deeply embedded in spermathecae. ..... 5
   Spermathecae with terminal knob about 4X as long as broad, most of structure deeply embedded in spermathecae. ..... 6

5. Common and individual sperm ducts subequal in length. Flagellomere I >0.35 mm. ..... Lutzomyia (verrucarum group) n.sp. #1 (Pl. 15-7)
   Common sperm duct much longer than individual sperm duct. Flagellomere I <0.35 mm. ..... L. columbiana (Pl. 15-19)
   L. disiuncta (Pl. 15-21)

6. Spermatheca with large terminal annulus, its length about 1/3 total length of spermatheca. ..... L. oresbia (Pl. 15-3)
   Spermatheca with smaller terminal annulus, its length less than 1/3 total length of spermathecae. ..... L. odax (Pl. 15-4)
   L. serrana (Pl. 15-2)
   L. ottolinai (Pl. 15-5)

7. Common sperm duct long, 3 or more times length of individual duct. ..... 8

Common sperm duct shorter than 3X length of individual duct. ..... 9

8. Spermathecae elongate with median constriction. Flagellomere I shorter than 0.20 mm. ..... L. ovallesi (Pl. 15-18)

Spermathecae without median constriction. Flagellomere I >0.25 mm. ..... L. verrucarum (Pl. 15-20)

L. moralesi (Pl. 15-15)

9. Individual sperm ducts very long, at least 3X length of common duct. ..... L. evansi (Pl. 15-23)

Individual sperm ducts shorter, less than 3X length of common duct. ..... 10

10. Spermathecae and common duct subequal in width. ..... 11

Spermathecae distinctly broader than common duct.. L. andina (Pl. 15-16)

L. aulari (Pl. 15-17)

11. Spermathecae with protruding terminal knob. ..... 12

Spermathecae with recessed terminal knob. ... L. nuneztovari (Pl. 15-24)

12. Labrum <0.28 mm. Spermathecae with terminal knob directed sideways, terminal annulus not "button-like." ..... L. nevesi (Pl. 15-22)

Labrum >0.30 mm. Spermathecae with terminal knob directed forward, not slanted & situated within a distinct button-shaped terminal annulus (townsendi complex). ..... L. amilcari (Pl. 15-10)

L. longiflocosa (Pl. 15-9)

L. quasitownsendi (Pl. 15-13)

Lutzomyia (verrucarum group) n.sp. #2 (Pl. 15-8)

L. sauroida (Pl. 15-11)

L. spinicrassa (Pl. 15-6)

L. townsendi (Pl. 15-12)

L. youngi (Pl. 15-14)

## Lutzomyia christophei (Fairchild & Trapido)

Plate 15-1

Phlebotomus christophei Fairchild & Trapido 1950: 409 (♂, ♀, Hato Mayor & Colonia San Rafael, Seibo, Dominican Republic).

Lutzomyia christophei: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Lewis 1967a: 74 (cf. to orestes ♀). Forattini 1973: 252 (♂, ♀ figs.). Martins et al. 1978: 93 (refs., dist.). Johnson 1984: 47 et seq. (coll. data, dist., rearing, exper. transmission of Leishmania). Young & Lawyer 1987: 56 (habits, Dominican Republic).

Distribution (Map 15-1). Hispaniola (Fairchild & Trapido 1950; Johnson 1984).

Remarks. Johnson (1984) studied the distribution, habits and disease relationships of sand flies from the Dominican Republic. Lutzomyia christophei was rarely encountered, but it is the suspected vector of Leishmania because it is anthropophilic, unlike L. cayennensis that is the only other sand fly species occurring on the island. Furthermore, Johnson demonstrated that reared females could experimentally transmit the endemic Leishmania (Isabel strain) to hamsters.

## Lutzomyia orestes (Fairchild & Trapido)

Plate 15-1

Phlebotomus orestes Fairchild & Trapido 1950: 410 (♂, near Minas, Camaguey, Cuba).

Phlebotomus sp. Avila et al. 1969: 3 (biting man, Cuba).

Lutzomyia orestes: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Lewis 1967b: 74 (♂, ♀ figs., Cayman Brac, West Indies). Mendoza et al. 1983a: 172 (biology); 1983b: 257 (feeding behavior, Cuba).

Distribution (Map 15-2). Cuba (Fairchild & Trapido 1950; Mendoza et al. 1983a,b); Cayman Brac, W.I. (Lewis 1967b).

Remarks. Lutzomyia orestes is structurally similar to L. christophei and has been found in Don Martin cave, Boca de Jaruco, Havana Prov., Cuba, where Avila et al. (1969) and Mendoza et al. (1983a,b) observed females attacking man in the daytime. Females also feed on lizards and are

gonotrophically disconcordant. Mendoza et al. (1983a) reared this species and provided photographs of the pupa and mature larva.

Lutzomyia serrana (Damasceno & Arouck)

Plate 15-2

Flebotomus serranus Damasceno & Arouck 1949: 843 (♂, Serra da Piriabas, Pará, Brazil).

Phlebotomus guayasi Rodriguez 1956: 76 (♂, ♀, Guayas, Ecuador). Fairchild & Hertig 1961b: 237 (as synonym of serranus, refs.).

Lutzomyia serrana: Barretto 1962: 97 (listed). Forattini 1973: 269 (figs., tax.). Leger et al. 1977: 222 (♂ fig., French Guiana). Martins et al. 1978: 117 (figs., refs., dist.). Young 1979: 73 (refs., figs.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 404 (Acre, Brazil). Ramirez Perez et al. 1982b: 58 (Tachira, Venezuela, figs.). Young & Rogers 1984: 599 (Ecuador). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Hashiguchi et al. 1985a: 442 (Ecuador). Murillo & Zeledon 1985: 875 (♂, ♀ figs., Costa Rica). Ryan 1986: 113 (figs., Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Alexander 1987: 554 (dispersal data, Colombia). Young et al. 1987: 588 (negative for flagellates, Colombia). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 15-2). Mexico; Honduras; Nicaragua (Martins et al. 1978); Costa Rica (Murillo & Zeledon 1985); Panama (Fairchild & Hertig 1961a,

localities in Canal Zone & Provinces of Chiriqui, Bocas del Toro & Panama); Colombia (Young 1979; Young et al. 1987); Venezuela (Ramirez Perez et al. 1982b); French Guiana (Leger et al. 1977); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Ecuador (Rodriguez 1956; Hashigushi et al. 1985); Peru (Llanos 1981); Bolivia (Martins et al. 1978; Le Pont & Desjeux 1986).

Remarks. Lutzomyia serrana has a widespread geographic distribution and in Colombia, at least, is more abundant at elevations from 700-1200 m a.s.l. than in lowland forests. Hanson (1968) described and figured the larva and pupa of L. serrana from reared specimens. He collected immatures in soil taken between buttressed roots in Panama. Females of this species are anthropophilic but have not been found naturally infected with Leishmania.

## Lutzomyia oresbia (Fairchild & Hertig)

Plate 15-3

Phlebotomus oresbius Fairchild & Hertig 1961b: 240 (♂, ♀, Santa Clara, Chiriqui, Panama).

Lutzomyia oresbia: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Forattini 1973: 263 (figs.). Martins et al. 1978: 116 (dist.). Christensen et al. 1983: 466 (listed, Panama). Murillo & Zeledon 1985: 71 (figs., Costa Rica).

Distribution (Map 15-1). Panama (Fairchild & Hertig 1961b); Costa Rica (Murillo & Zeledon 1985).

## Lutzomyia odax (Fairchild & Hertig)

Plate 15-4

Phlebotomus odax Fairchild & Hertig 1961b: 238 (♂, ♀, Almirante, Bocas del Toro, Panama).

Lutzomyia dubia Martins, Falcao & Silva 1965: 4 (♂, Abuna, Rondonia, Brazil). Forattini 1973: 261 (as synonym of odax, figs., tax.).

Lutzomyia odax: Barretto 1962: 97 (listed). Theodor 1965: 183 (listed). Leger et al. 1977: 222 (French Guiana). Martins et al. 1978: 115 (dist.). Young 1979: 73 (♂ fig., refs.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Murillo & Zeledon 1985: 71 (♂, ♀, Costa Rica). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 15-3). Honduras; Nicaragua (Martins et al. 1978); Costa Rica (Murillo & Zeledon 1985); Panama; Brazil (Martins et al. 1978); French Guiana (Leger et al. 1977).

Remarks. We have not seen males of L. odax from Brazil but Forattini (1973) and Martins et al. (1978) consider L. dubia, described from there, to be a junior synonym of L. odax.

## Lutzomyia ottolinai (Ortiz & Scorza)

Plate 15-5

Phlebotomus ottolinai Ortiz & Scorza 1963: 345 (♂, ♀, Rancho Grande, Aragua, Venezuela).

Lutzomyia ottolinai: Theodor 1965: 183 (listed). Forattini 1973: 265 (♂ fig.). Martins et al. 1978: 116 (refs.). Ramirez Perez et al. 1978: 52 (♂, ♀ figs., Aragua, Venezuela). Feliciangeli 1980: 246 (figs., keyed).

Distribution (Map 15-4). Venezuela (type locality).

Remarks. Lutzomyia ottolinai is uncomfortably close to L. serrana and the illustrations of both sexes of the former species by Ramirez Perez et al. (1978) support the possibility that the species are conspecific. More specimens, preferably topotypes, of L. ottolinai are needed to clarify its status.

## Lutzomyia spinicrassa Morales, Osorno, Osorno & Hoyos

Plate 15-6

Lutzomyia spinicrassa Morales, Osorno, Osorno & Hoyos 1969b: 383 (♂, ♀, Boyaca, Colombia). Young 1979: 86 (figs., refs.). Alexander 1987: 554 (dispersal study). Kreutzer et al. 1987: 610 (brain cell karotypes). Young et al. 1987: 588 (naturally infection with Leishmania braziliensis, Norte de Santander, Colombia). Young et al. 1987: 588

(naturally infected with Leishmania braziliensis, Norte de Santander, Colombia).

Lutzomyia townsendi (not townsendi Ortiz): Ramirez Perez et al. 1982b: 53 (Tachira, Venezuela).

Distribution (Map 15-3). Colombia (Young et al. 1987); Venezuela (Ramirez Perez et al. 1982b).

Remarks. This species, regarded as a suspected vector of Leishmania braziliensis in Norte de Santander, Colombia, is locally abundant in coffee plantations at Arboledas, Durania and nearby localities. Females are aggressive man-biters throughout most of the year.

Lutzomyia (verrucarum group) n.sp. #1

Plate 15-7

Distribution (Map 15-2). Venezuela (♂♂, ♀♀, Yacambu National Park, Lara, 1840 m above sea level, 1987, D. Feliciangeli).

Remarks. This distinctive species will be described and named by D. Feliciangeli in 1988.

Lutzomyia (verrucarum group) n.sp. #2

Plate 15-8

Distribution (Map 15-10). Colombia (Reventones, Cundinamarca, 1657 m above sea level, 1986-1987, A. Morales, C. Ferro & D. Young).

Remarks. The male differs from others in the townsendi complex by the shape and setation of the parameres. Isozyme profiles of males and females also support its recognition as a distinct species (R.D. Kreutzer, unpub. data). Like most other females in this complex, Lutzomyia sp. #2 is anthropophilic and is the dominant man-biter at Reventones, Colombia, where Leishmania braziliensis is endemic (A. Corredor, pers. comm., 1987).

## Lutzomyia longiflocosa Osorno, Morales & Hoyos

Plate 15-9

Lutzomyia longiflocosa Osorno, Morales & Hoyas 1970: 1 (♂, ♀, Tello, Huila, Colombia). Martins et al. 1978: 127. Young 1979: 80 (o fig.). Feliciangeli & Murillo 1987: 144 (cf. to youngi).

Distribution (Map 15-3). Colombia (type locality).

## Lutzomyia amilcari Cardona

Plate 15-10

Lutzomyia amilcari Cardona 1984: 63 (♂, Yacambú National Park, Lara, Venezuela). Feliciangeli & Murillo 1987: 144 (cf. to youngi, ♂ fig.).

Distribution (Map 15-5). Venezuela (type locality).

Remarks. The original illustration of the male genitalia (Cardona 1984) was based on specimens unduly flattened on the microslide by the weight of

the coverslip. Nevertheless, the structure of the paramere appears to be distinctive and serves to separate this species from others in the verrucarum species group.

## Lutzomyia sauroida Osorno, Morales & Osorno

Plate 15-11

Lutzomyia sauroida Osorno, Morales & Osorno 1972c: 433 (♂, Vereda San Pedro, Boyacá, Colombia). Martins et al. 1978: 128. Young 1979: 86 (♂ fig.).

Lutzomyia sauroidea: Feliciangeli & Murillo 1987: 144 (cf. to youngi).

Distribution (Map 15-6). Colombia (Osorno et al. 1972c).

Remarks. Lutzomyia sauroida closely resembles L. townsendi (Ortiz) in details of the terminalia (Young 1979), but the forms are treated here as separate species for the present. Since L. sauroida was described, several other species in the townsendi complex have been discovered and definitive conclusions about the status of each must await further studies.

## Lutzomyia townsendi (Ortiz)

Plate 15-12

Phlebotomus townsendi Ortiz 1959: 23 (♂, Rancho Grande, Aragua, Venezuela). Ortiz & Scorza 1963: 347 (♂, ♀). Scorza et al. 1967; 1968a-f (ecology, habits).

Lutzomyia townsendi: Theodor 1965: 183 (listed). Forattini 1973: 271 (figs.). Ramirez Perez 1978: 52 (♂, ♀ figs., Aragua, Venezuela). Martins et al. 1978: 129 (refs.). Young 1979: 50 (♂ fig.). Feliciangeli 1980: 246 (keyed, figs.). Feliciangeli & Murillo 1987: 144 (cf. to youngi).

Distribution (Map 15-1). Venezuela (type locality).

Remarks. We have not seen representatives of this species from localities other than the type locality. Records from Tachira and Trujillo States, Venezuela, represent other verrucarum group species, not L. townsendi.

The ecology and habits of L. townsendi at Rancho Grande, Venezuela, were studied in detail by J. Scorza and colleagues (1967,; 1968a-e).

## Lutzomyia quasitownsendi Osorno, Osorno & Morales

Plate 15-13

Lutzomyia quasitownsendi Osorno, Osorno & Morales 1972b: 10 (♂, ♀, Barbosa, Santander, Colombia). Martins et al. 1978: 128. Young 1979: 86 (♂ fig.). Feliciangeli & Murillo 1987: 144 (cf. to youngi, o fig.).

Distribution (Map 15-5). Colombia (type locality).

Lutzomyia youngi Feliciangeli & Murillo

Plate 15-14

Lutzomyia youngi Feliciangeli & Murillo 1987: 141 (♂, ♀, Las Calderas, Trujillo, Venezuela). Murillo & Zeledon 1985: 71 (♂, ♀ figs., Costa Rica).

Lutzomyia townsendi (not townsendi Ortiz): Calderón 1973: 87 (Mérida State, Venezuela, in leishmaniasis endemic area). Carnevali & Scarza 1976: 33 (experimentally infected with Leishmania). Mogollón et al. 1977: 206 (altitudinal distribution, Trujillo State, Venezuela). Castro & Scorza 1977: 224 (rearing). Valera et al. 1978: 238 (mention). Scorza et al. 1979: 293 (as possible vector of Le. garnhami). Scarza & Carnevali 1981: 229 (infected with Monocystis chagasi). Moreno & Scorza 1981: 179 (as experimental host for Leishmania). Marquez & Scorza 1982: 229 (age grading). Carnevali & Scorza 1982: 353 (dermal factors influencing sand fly infections). Scorza & Delgado 1982: 217 (as experimental host for Leishmania). Scorza & Anez 1984: 139 (as experimental host of Leishmania garnhami). Anez & Oviedo 1985: 739 (larval food, rearing). Anez et al. 1985: 113 (experimental study as Leishmania vector). Killick-Kendrick 1985: 752 (experimental infections with Leishmania).

Distribution (Map 15-4). Costa Rica (Murillo & Zeledon 1985); Venezuela (Feliciangeli & Murillo 1987).

Remarks. Aside from slight differences in the setation of the parameres, the males of L. townsendi and L. youngi are virtually impossible to separate

by structure. R.D. Kreutzer (unpub. data) observed that both males and females of the two species can be separated by their isozyme profiles.

Lutzomyia youngi is a suspected vector of Leishmania in Costa Rica and in Venezuela (see many refs. given above.).

## Lutzomyia moralesi Young

Plate 15-15

Lutzomyia moralesi Young 1979: 80 (♂, ♀, near Cali, Valle, Colombia). Feliciangeli et al. 1984: 595 (cf. to avlari).

Distribution (Map 15-5). Colombia (type locality).

Remarks. There are no man-biting records of this species which, to date, is known only from the type locality.

## Lutzomyia andina Osorno, Osorno & Morales

Plate 15-16

Lutzomyia verrucarum (not verrucarum Townsend): Osorno et al. 1967: 36 (Cundinamarca, Colombia).

Lutzomyia andina Osorno, Osorno & Morales 1972b: 2 (♂, ♀, Charquito, Cundinamarca, Colombia). Young 1979: 75 (♂ figs.). Feliciangeli et al. 1984: 595 (cf. to aulari).

Distribution (Map 15-1). Colombia (Osorno et al. 1972b).

Remarks. The type locality at Charquito near the Rio Bogota is mountainous with numerous rock croppings which are used by males and females of L. andina as resting sites. Females are anthropophilic, biting during the day and night.

The widened end of the shorter basal spine of the male style is unique among the verrucarum group species.

Lutzomyia aulari Feliciangeli, Ordonez & Manzanilla

Plate 15-17

Lutzomyia aulari Feliciangeli, Ordonez & Manzanilla 1984: 592 (♂, Loma Abajo, Trujillo, Venezuela; ♀, Trujillo, Venezuela).

Lutzomyia columbiana (not columbiana Ristorcelli & Van Ty): Feliciangeli 1980: 245 (Trujillo, Venezuela).

Distribution (Map 15-6). Venezuela (Feliciangeli et al. 1984 & ♂♂, ♀♀, Yacambu National Park, Lara, 1840 m above sea level, 1987, D. Feliciangeli).

Remarks. Through the kindness of D. Feliciangeli, we examined a series of males and females of L. aulari captured recently in Lara State, Venezuela. The female is morphologically indistinguishable from that of L. andina. The males are also very close, but the shorter basal spine

of the male style of L. aulari is pointed at its tip, unlike that of L. andina. Further studies and material may indicate that these taxa should be recognized as subspecies.

## Lutzomyia ovallesi (Ortiz)

Plate 15-18

Phlebotomus ovallesi Ortiz 1952: 155 (♂, Duaca, Lara, Venezuela). Lewis & Garnham 1959: 87 (♀, Belize).

Lutzomyia ovallesi: Barretto 1962: 98 (listed). Mogollon et al. 1977: 209 (Venezuela). Ramirez Perez et al. 1978: 52 (♂, ♀ figs., Venezuela). Martins et al. 1978: 128 (refs., dist.). Young 1979: 84 (♂, ♀ figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Perez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela). Bonfante Garrido 1983: 740; 1984: 850 (Venezuela). Murillo & Zeledon 1985: 75 (♂, ♀ figs., Costa Rica). Young et al. 1987: 588 (natural flagellate infections, Colombia). Alexander 1987: 554 (dispersal study, Colombia). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela).

Distribution (Map 15-7). Mexico; Belize; Honduras (Martins et al. 1978); Costa Rica (Murillo & Zeledon 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Young et al. 1987); Venezuela (Mogollon et al. 1977; Martins et al. 1978; Ramirez Perez et al. 1978, 1981, 1982a,b; Bonfante Garrido 1983; Feliciangeli 1987a,b). Trinidad (Aitken 1968).

Remarks. Forattini (1973) mistakenly considered L. ovallesi to be conspecific with L. nuneztovari.

Females of the former species have been found naturally infected with flagellates of unknown identity in Belize, Panama, and Colombia (Williams 1970; Young et al. 1987).

## Lutzomyia columbiana (Ristorcelli & Van Ty)

Plate 15-19

Phlebotomus columbianus Ristorcelli & Van Ty 1941: 263 (♀, Valle de capuli, Narino, Colombia). Rozeboom 1947b: 705 (♂ figs.). Sherlock 1962: 322 (♂, ♀).

Phlebotomus monticolus var. incarum Ristorcelli & Van Ty 1941: 266 (♀, Valle de Capuli, Narino, Colombia). Rozeboom 1947b: 705 (as junior synonym of columbianus).

Lutzomyia columbiana: Barretto 1962: 97. Martins et al. 1978: 126 (refs.). Young 1979: 75 (refs., figs.).

Distribution (Map 15-8). Colombia (Young 1979).

Remarks. Females of L. columbiana are aggressive man-biters and were implicated as vectors of Bartonella during an epidemic of baronellosis in southern Colombia in the 1930's and early 1940's (Rozeboom 1947b). Populations of this sand fly remain high at Samaniego, Narino, Colombia

(C. Ferro, pers. comm.) but no recent human cases of bartonellosis have been observed or reported.

## Lutzomyia verrucarum (Townsend)

Plate 15-20

Phlebotomus verrucarum Townsend 1913: 107 (♂, ♀, Verrugas Canyon, Peru). Hertig 1942: 1 et seq. (habits, as vector of Bartonella). Rozeboom 1947.

Flebotomus verrucarum: Barretto 1947a: 228 (full refs.).

Lutzomyia verrucarum: Barretto 1962: 97 (listed). Theodor 1965: 183 (♂, ♀ figs.). Forattini 1973: 228 (♂, ♀ figs., tax.). Martins et al. 1978: 129 (ref., dist.). Llanos 1981: 183 (dist., Peru). Feliciangeli et al. 1984: 595 (cf. to aulari). Vargas & Perez 1985: 5 (Ancash, Peru).

Distribution (Map 15-9). Peru (Martins et al. 1978; Llanos 1981; Vargas & Perez 1985).

Remarks. Records of L. verrucarum from Venezuela (see Feliciangeli 1980) and Colombia (Osorno et al. 1967) represent other verrucarum group species, not L. verrucarum (Townsend).

Hertig (1942) studied the biology and habits of this important species in Peru where it has been incriminated as a vector of Bartonella and is also suspected of transmitting Leishmania to man. At present,

however, no natural leishmanial infections have been reported in wild-caught females. Specimens have been collected from elevations as high as 3300 m above sea level in Ancash, Peru (E. Perez, pers. comm.).

## Lutzomyia disiuncta Morales, Osorno & Osorno

Plate 15-21

Lutzomyia disiuncta Morales, Osorno & Osorno 1974: 443 (♂, ♀, Suba, Cundinamarca, Colombia). Martins et al. 1978: 126. Young 1979: 78 (o fig.).

Distribution (Map 15-4). Colombia (type locality).

Remarks. The type locality of L. disiuncta at Suba is a small cloud forest surrounded by pastures almost within the city limits of Bogota.

## Lutzomyia nevesi (Damasceno & Arouck)

Plate 15-22

Flebotomus nevesi Damasceno & Arouck 1956: 9 (♂, Rio Capim, Pará, Brazil).

Lutzomyia nevesi: Theodor 1965: 183. Velasco & Martins 1974: 94 (♀, Bolivia). Martins et al. 1978: 127 (refs., dist.). Young 1979: 45 (Ecuador). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Le Pont & Desjeux 1984: 282 (Bolivia). Young & Rogers 1984: 599 (listed, Ecuador). Arias et al. 1985: 1101 (natural flagellate infections, Brazil). Le Pont & Desjeux

1986: 314 (Bolivia). Ryan 1986: 112 (figs., Brazil). Young & Morales 1987: 662 (Amazonas, Colombia).

Lutzomyia evansi (in part, not evansi Nunez Tovar): Llanos 1973: 47 (♀ figs.).

Distribution (Map 15-8). Colombia (Young & Morales 1987); Ecuador (Young 1979); Peru (Llanos 1973; Martins et al. 1978); Bolivia (Velasco & Martins 1974; Le Pont & Desjeux 1984, 1986); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986).

Remarks. Forattini (1973) incorrectly treated this species as a junior synonym of L. pestanai belonging in the subgenus Psathromyia. Llanos (1973) figured the L. nevesi female (incorrectly as L. evansi) before it was fully described by Velasco & Martins in 1974.

Arias et al. (1985) reported unidentified flagellate infections in 33 out of 171 females of L. nevesi in Brazil.

## Lutzomyia evansi (Nunez Tovar)

Plate 15-23

Phlebotomus evansi Nunez Tovar 1924:44 (♂, Mariara, Carabobo, Venezuela).

Flebotomus evansi: Barretto 1947a: 198 (full refs.).

Lutzomyia evansi: Theodor 1965: 183 (listed). Mogollon et al. 1177: 209 (Venezuela). Ramirez Perez et al. 1978: 49 (♂, ♀ figs., venezuela). Martins et al. 1978: 126 (refs., dist.). Young 1979: 78 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Perez et al. 1982: 14 (♂, ♀ figs., Venezuela). Bonfante Garrido 1983: 740; 1984: 850 (Venezuela). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledon 1985: 79 (♂, ♀ figs., Costa Rica). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela).

Distribution (Map 15-10). Guatemala (Fairchild & Hertig 1959); El Salvador; Nicaragua (Martins et al. 1978); Honduras (Young 1979; Navin et al. 1985); Costa Rica (Murillo & Zeledon 1985); Colombia (Young 1979); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978, 1982; Bonfante Garrido 1983; Feliciangeli 1987a,b).

Remarks. Records of L. evansi in Peru (Llanos 1981) are questionable based on the fact that specimens illustrated as "L. evansi" by Llanos (1973) represent L. nuneztovari (♂) and L. nevesi (♀), not L. evansi (Nunez Tovar).

## Lutzomyia nuneztovari (Ortiz)

Plate 15-24

Phlebotomus nuneztovari Ortiz 1954: 232 (♂, Duaca, Lara, Venezuela).

Lutzomyia nuneztovari: Theodor 1965: 183 (listed). Forattini 1973: 265 (as synonym of ovallesi). Ramirez Perez et al. 1978: 52 (♂, ♀ figs.,

Venezuela). Martins et al. 1978: 127. Young 1979: 83 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (keyed). Ramirez Perez 1982b: 58 (♂, ♀ figs., Venezuela). Christensen et al. 1983: 446 (Panama). Le Pont & Desjeux 1984: 281 (cf. to nuneztovari anglesi). Alexander 1987: 554 (dispersal study, Colombia). Young et al. 1987: 588 (negative for flagellates, Colombia).

Lutzomyia evansi (in part, not evansi Nunez Tovar): Llanos 1973: 47 (♂ fig.).

Lutzomyia nuneztovari anglesi Le Pont & Desjeux 1984: 277 (♂, ♀, Tocania, La Paz, Bolivia).

Distribution (Map 15-9). Guatemala (1 ♂ no. 426, km 81, Nov. 1949, no other data, Leon coll.); Honduras (3 ♂♂, Tela, Lancetilla Valley, June 1953, tree trunk, Hils); Panama (4 ♂♂, Santa Clara, Chiriqui, April 1955, tree trunks in coffee plantation, Hartmann); Colombia (Young 1979; Young et al. 1987); Peru (Llanos 1973, as evansi, in part); Bolivia (Le Pont & Desjeux 1984); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978, 1982b).

Remarks. This species has not been previously reported in Guatemala, Honduras and Peru. Llanos (1973) figured a male of L. nuneztovari from Cusco, Peru, that she misidentified as L. evansi. One of us confirmed this determination in 1988 from males and females of L. nuneztovari in the collection at the National Institute of Health, Lima.

Le Pont & Desjeux (1984) noted that males of L. nuneztovari from Bolivia differed from those captured elsewhere by presence of a small subterminal setae on each style, by the longer genital filaments (4.9X length of pump), by the longer lateral lobes that extend well beyond the ends of the parameres, and by other metrical differences.

In comparing Bolivian specimens of L. nuneztovari with those found elsewhere, we noted that the presence or absence of the subterminal seta on the style depended on individual specimen, not locality. For example, 1 male from Honduras has this seta, whereas it was absent from the 2 other males captured from the same site. The Panama males showed similar variation (subterminal seta of style present in 1 male; absent in 3 others).

Two males from Bolivia, kindly sent by F. Le Pont, have a shorter genital pump/filament ratio (2.8X) than indicated in the original description and therefore do not differ from other males examined from Colombia, Panama, etc. in this aspect.

In view of these observations, we reject the status of the Bolivian specimens as a distinct subspecies. Leishmania sp. was reported in L. nuneztovari from this country by Le Pont & Desjeux (1984).

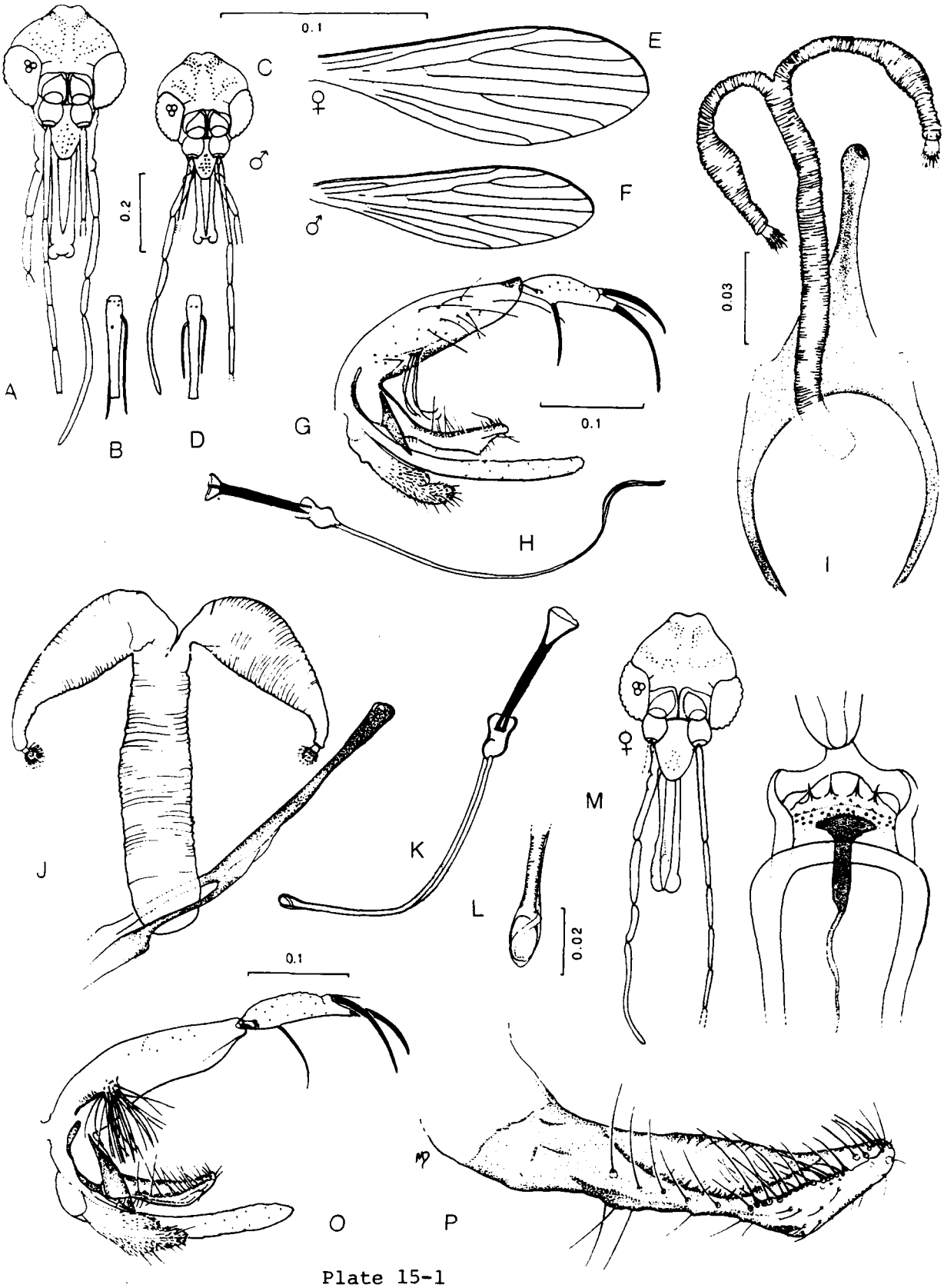



Plate 15-1

Lutzomyia orestes. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Male terminalia; H. Genital pump & filaments; I. Spermathecae.

Lutzomyia christophei. J. Spermathecae; K. Genital pump & filaments; L. Tip of genital filament; M. Female head; N. Female cibarium; O. Male terminalia; P. Paramere.




Plate 15-2

Lutzomyia serrana. A. Female head; B. Female flagellomere II; C. Female cibarium; D. Spermathecae; E. Male terminalia; F. Genital pump & filaments; G. Coxite setal tuft; H. Paramere (figs. A-C from Young 1979).

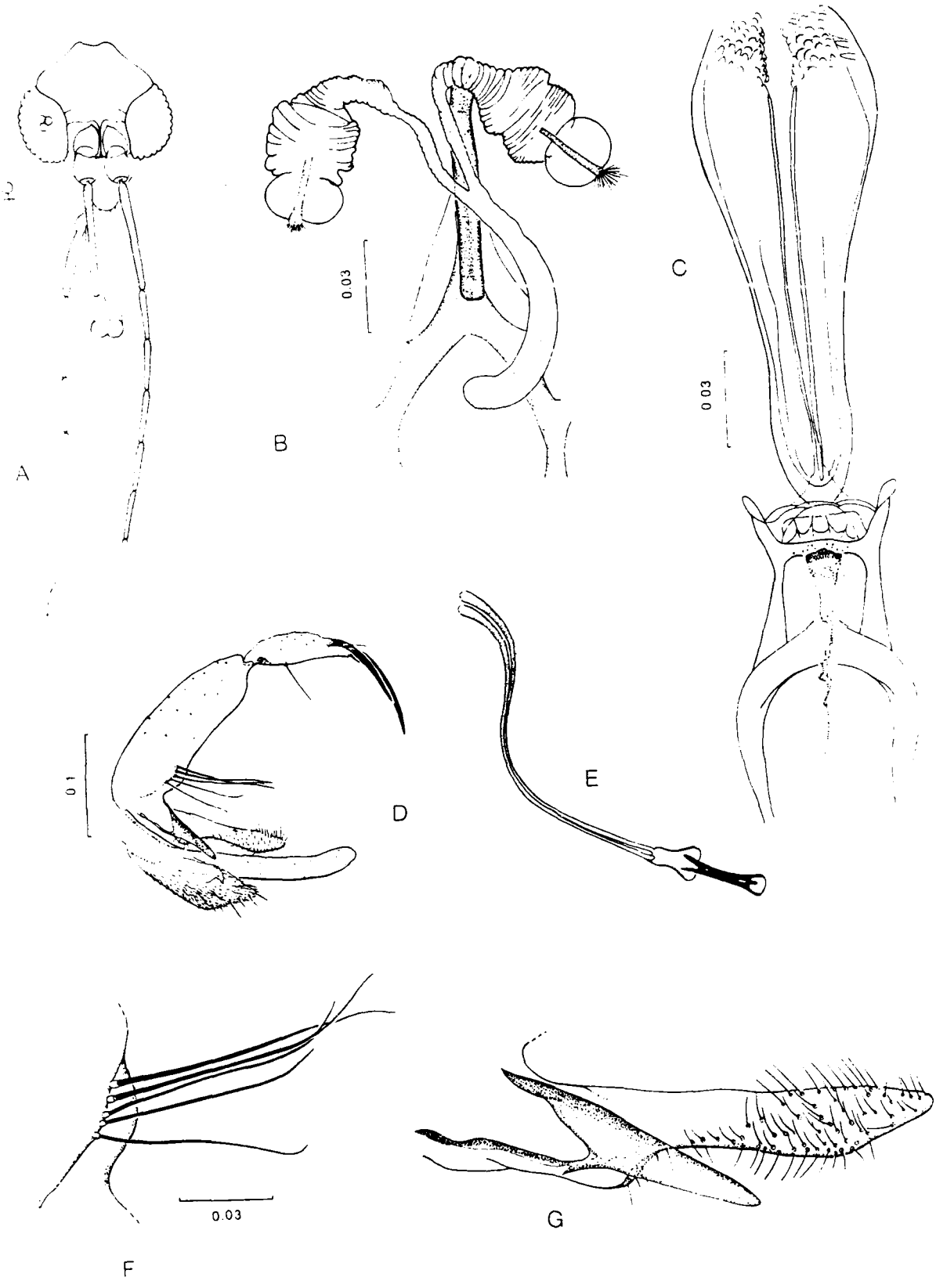



Plate 15-3

Lutzomyia oresbia. A. Female head; B. Spermathecae; C. Female cibarium & pharynx; D. Male terminalia; E. Genital pump & filaments; F. Coxite tuft; G. Paramere & aedeagus.

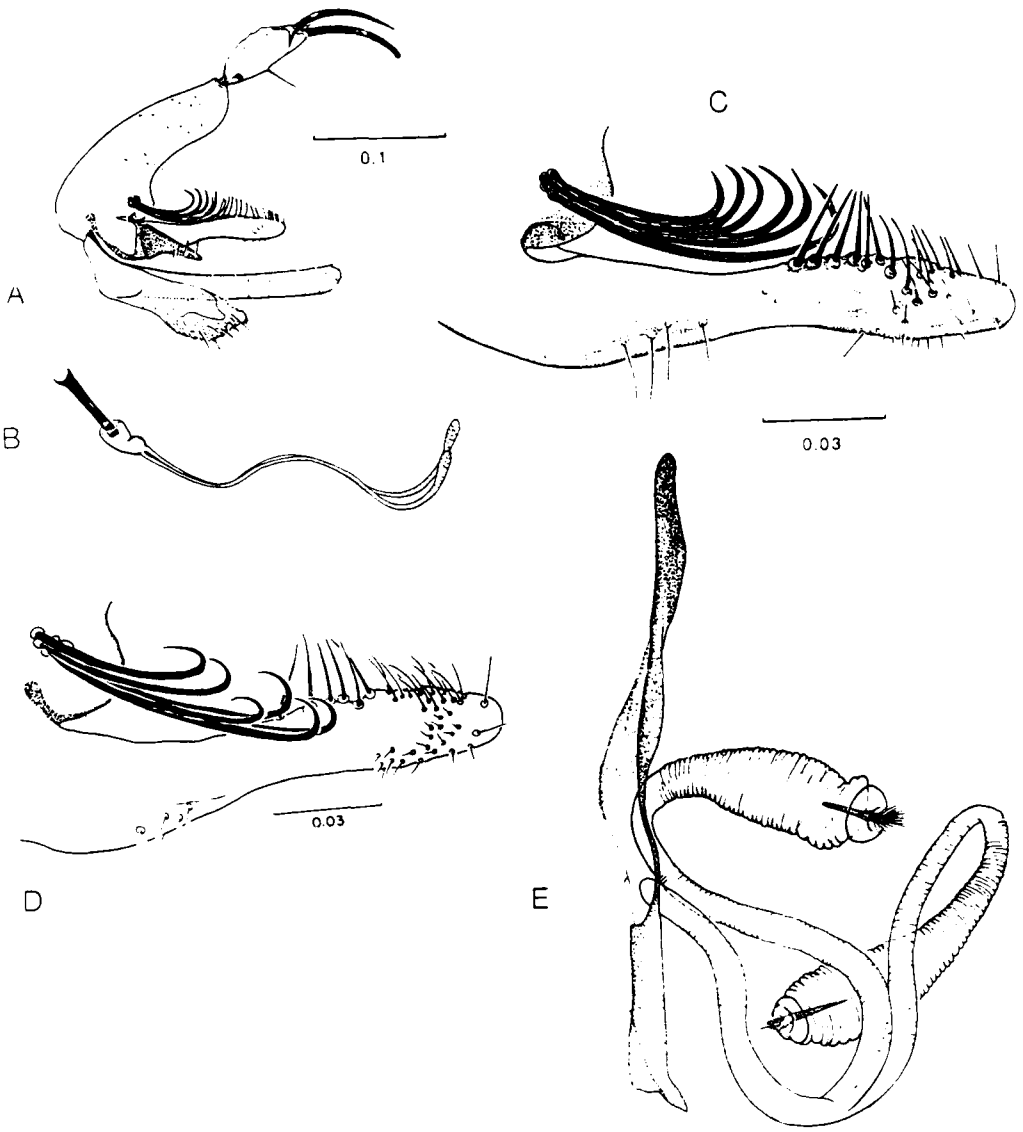



Plate 15-4

Lutzomyia odax. A. Male terminalia; B. Genital pump & filaments; C. Paramere; D. Paramere (different aspect); E. Spermathecae.

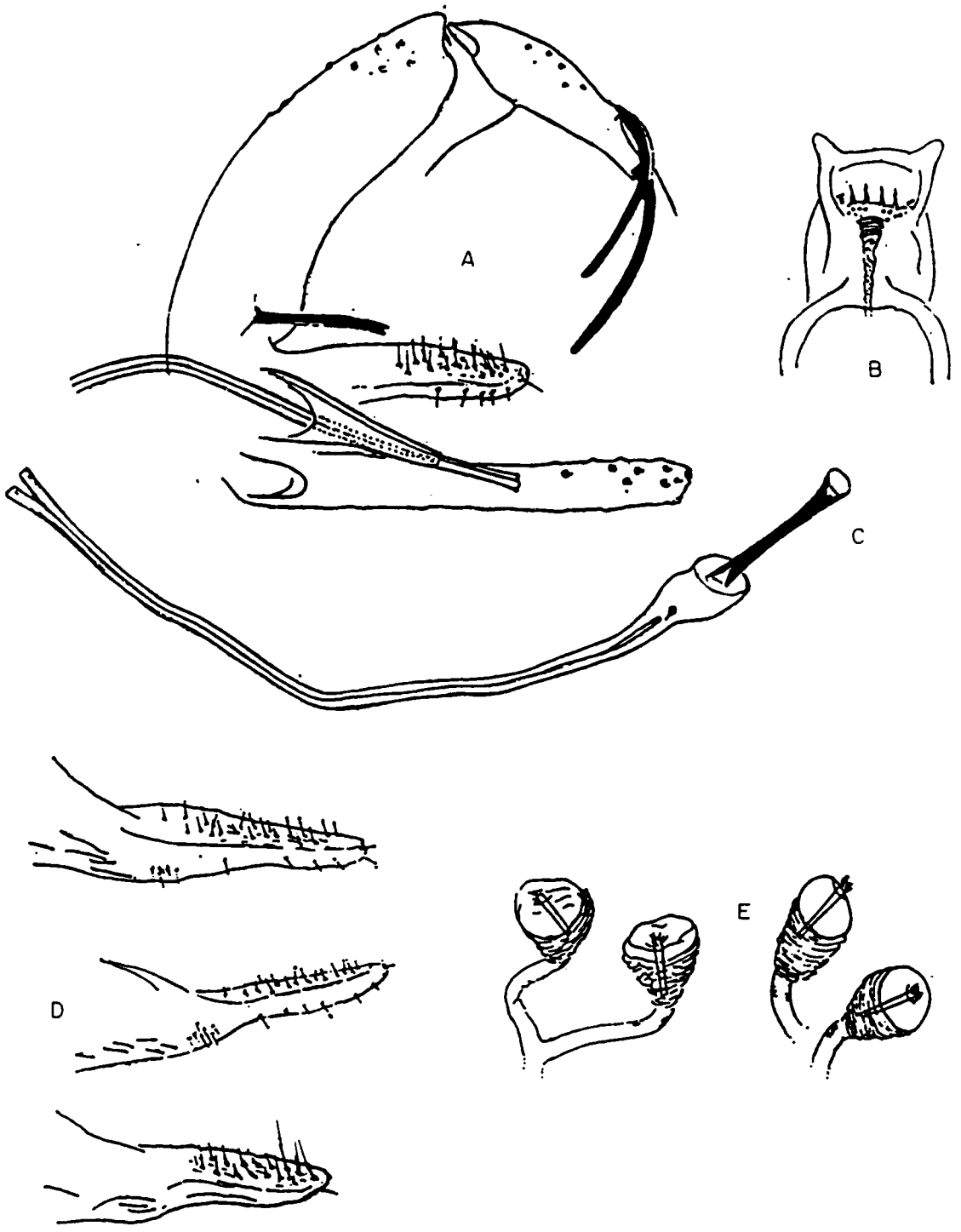



Plate 15-5

Lutzomyia ottolinai. A. Male terminalia; B. Female cibarium; C. Genital pump & filaments; D. Parameres, different views; E. Spermathecae (figs. from Ortiz & Scorza 1963).

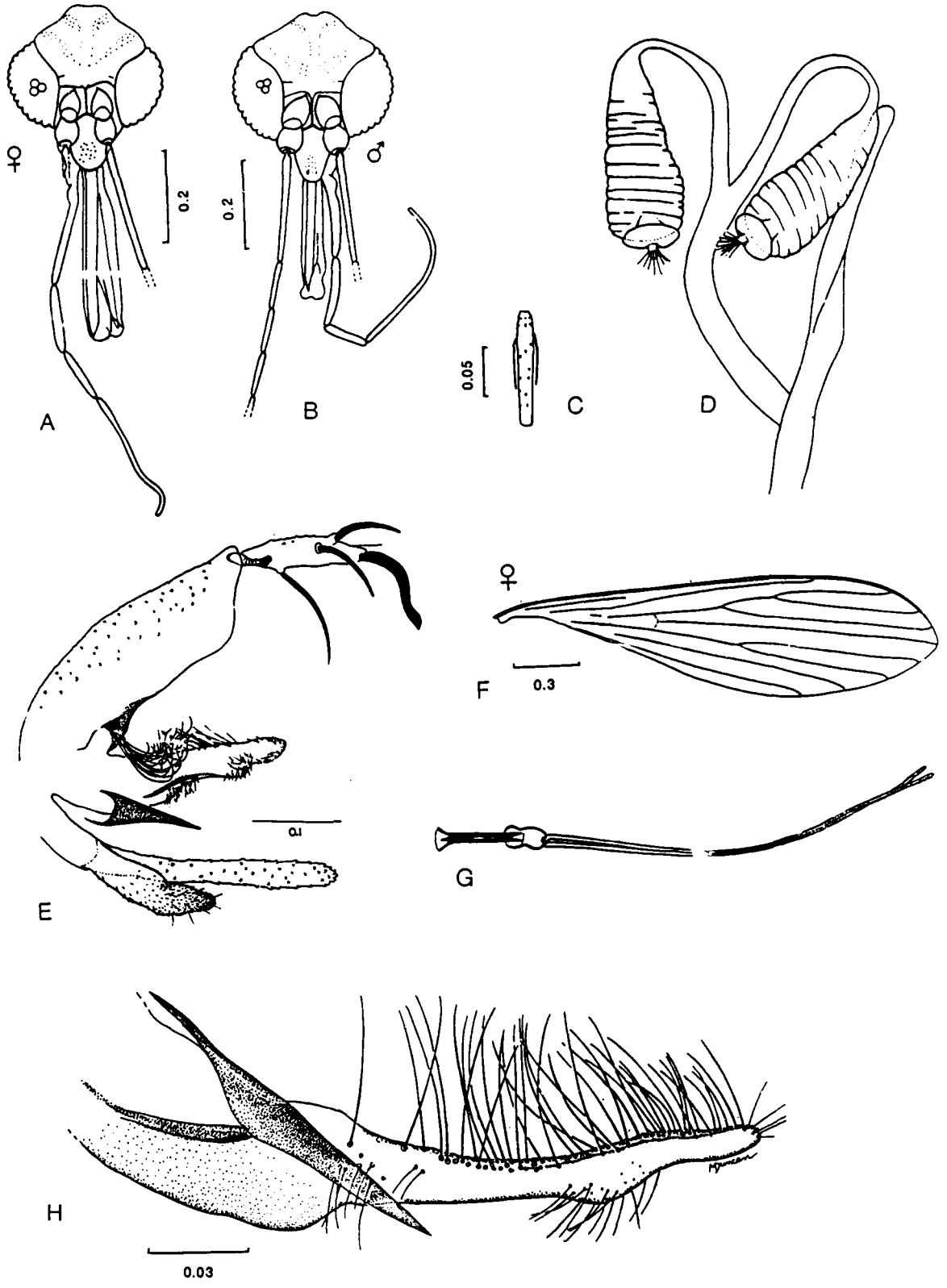



Plate 15-6

Lutzomyia spinicrassa. A. Female head; B. Male head; C. Male flagellomere II; D. Spermathecae; E. Male terminalia; F. Female wing; G. Genital pump & filaments; H. Paramere (fig. E from Young 1979).

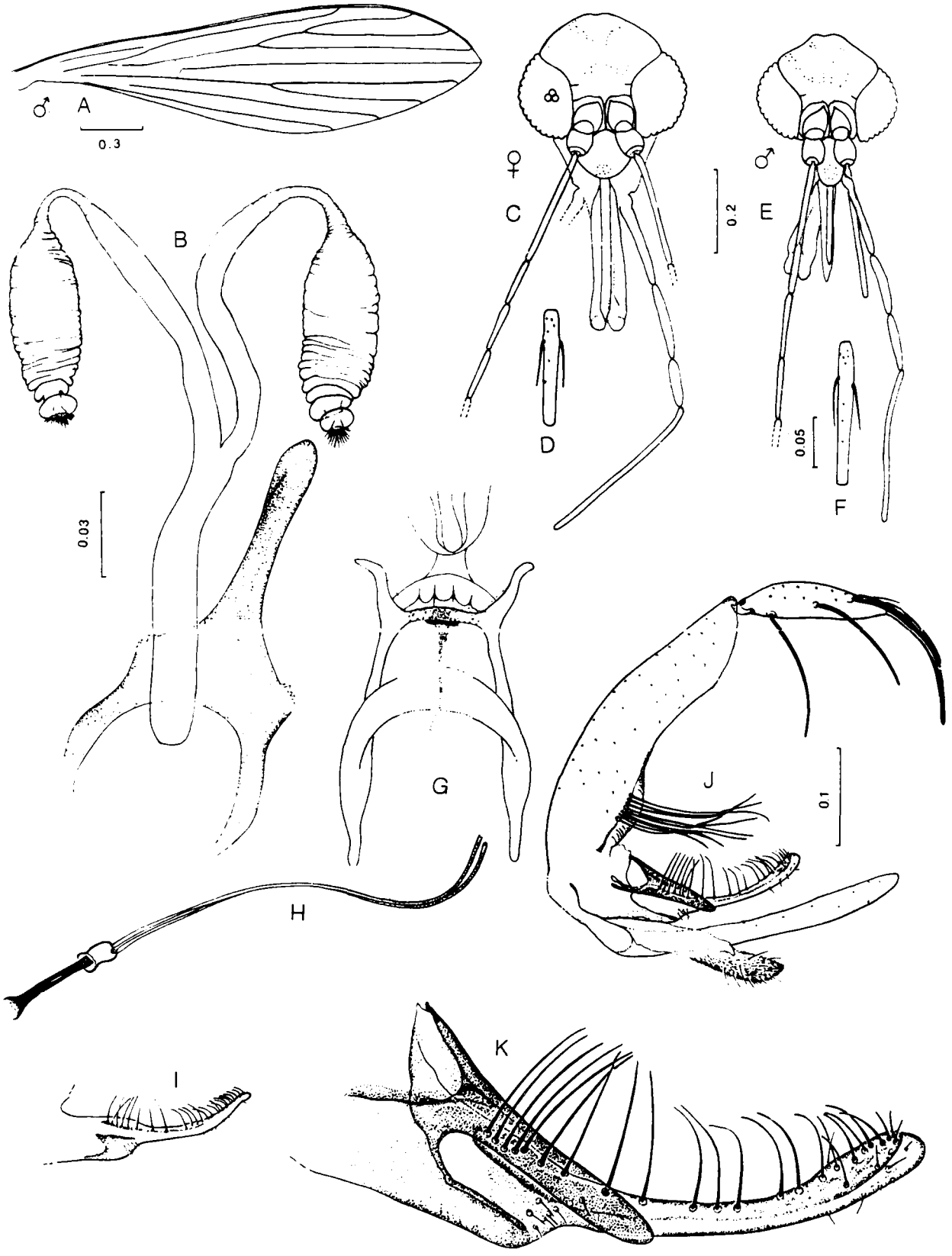



Plate 15-7

Lutzomyia (verrucarum group) n.sp. #1. A. Male wing; B. Spermathecae; C. Female head; D. Female flagellomere II; E. Male head; F. Male flagellomere II; G. Female cibarium; H. Genital pump & filaments; I. Paramere; J. Male terminalia; K. Paramere.

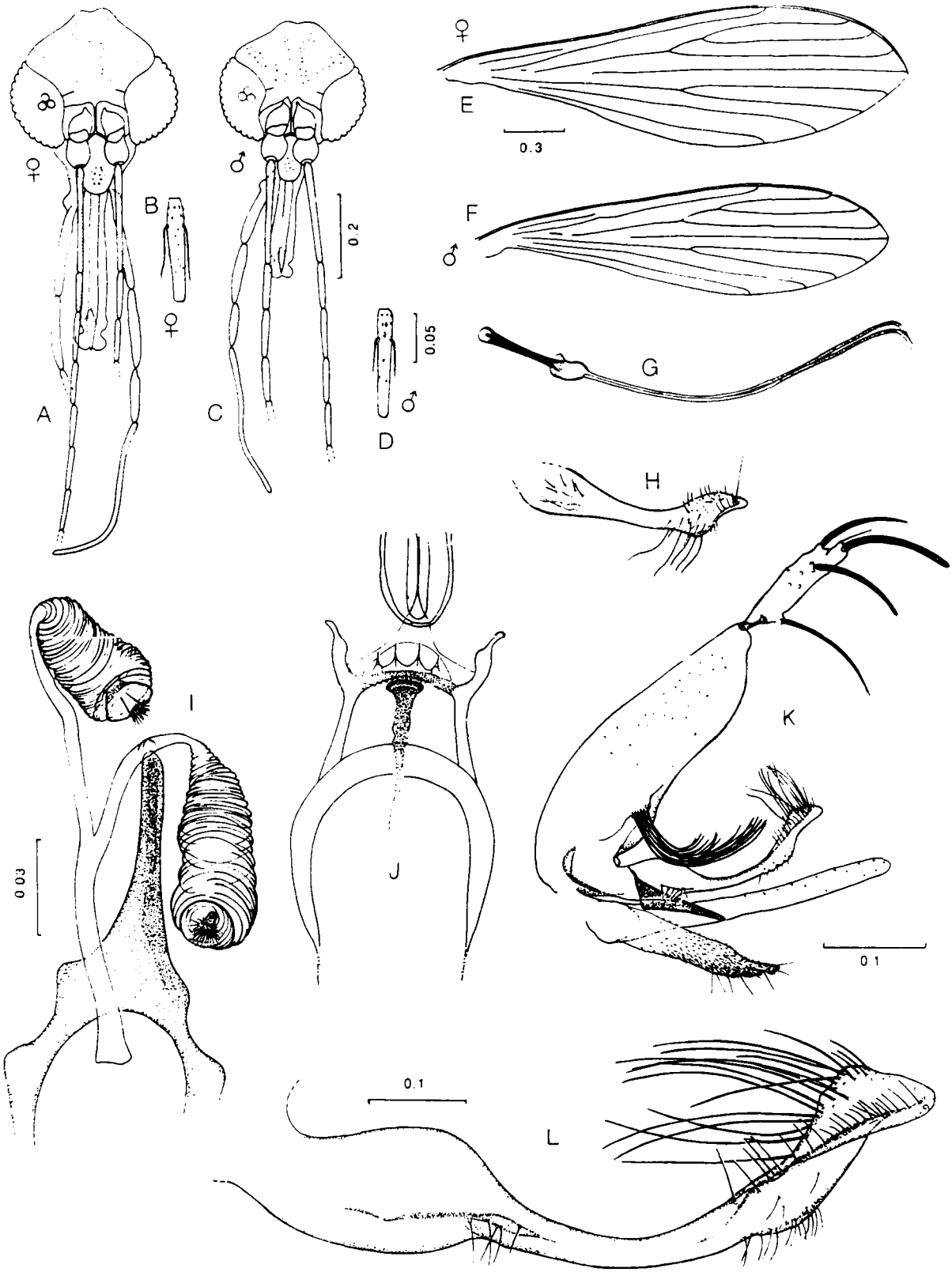



Plate 15-8

Lutzomyia (verrucarum group) n.sp. #2. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Paramere; I. Spermathecae; J. Female cibarium; K. Male terminalia; L. Paramere.

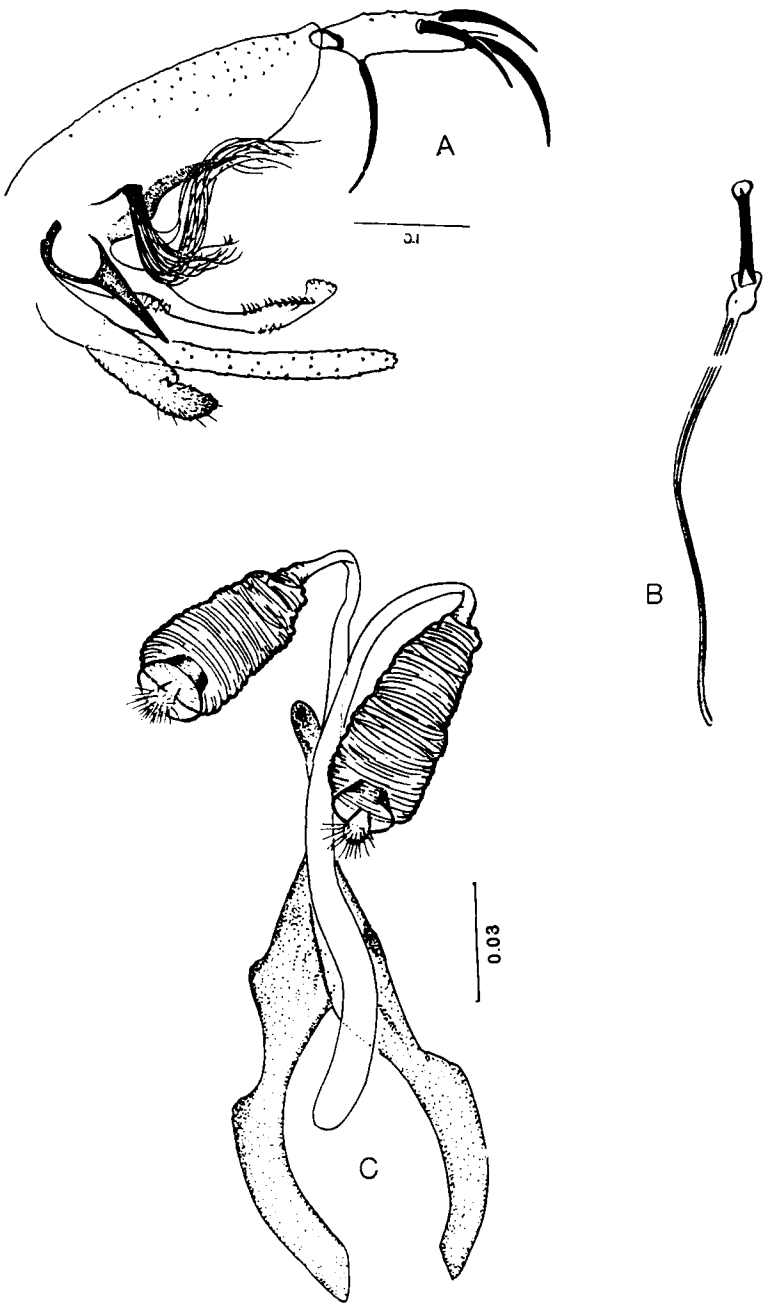



Plate 15-9

Lutzomyia longiflocosa. A. Male terminalia; B. Genital pump & filaments; C. Spermathecae (fig. A from Young 1979).

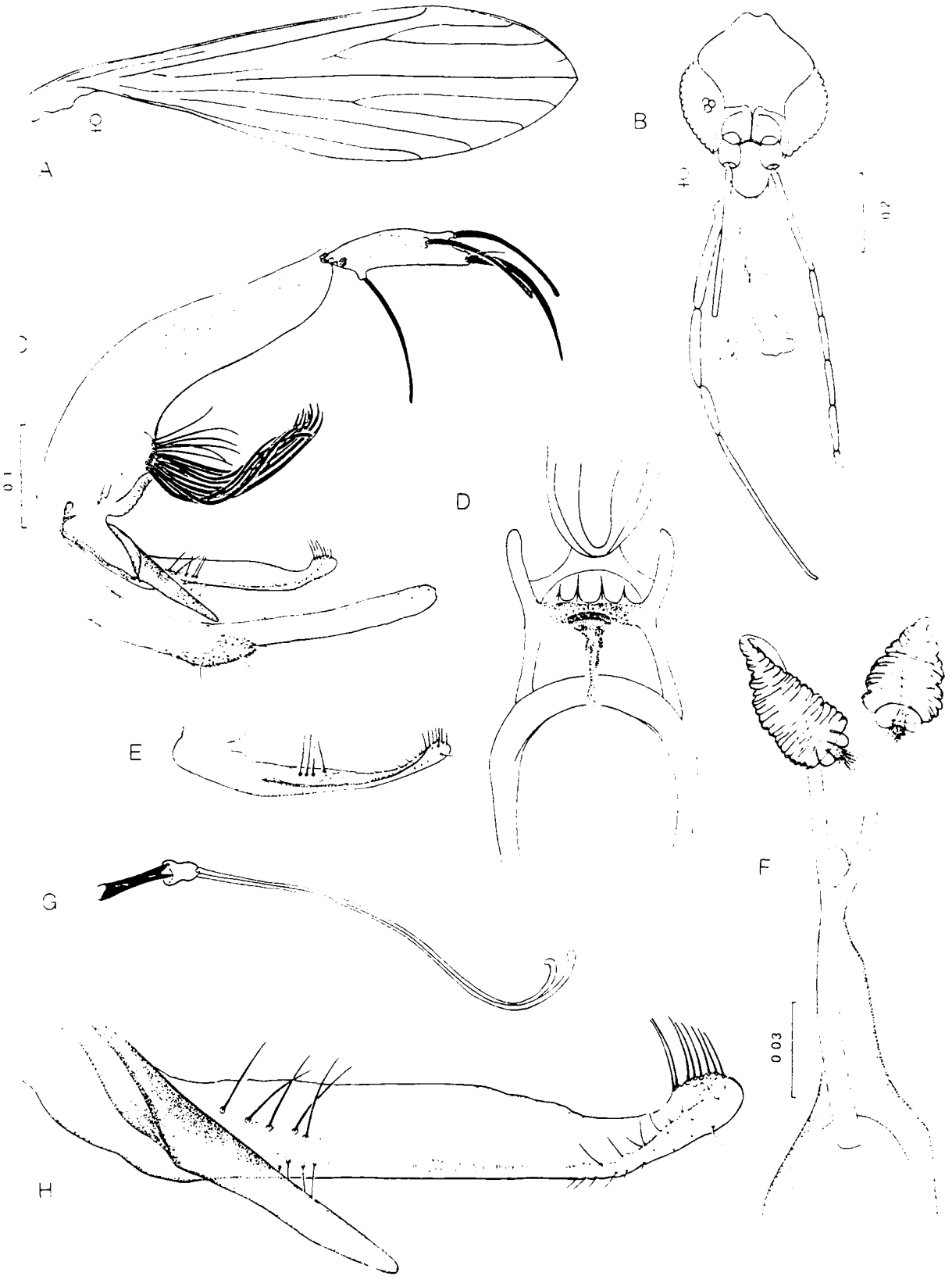



Plate 15-10

Lutzomyia amilcari. A. Female wing; B. Female head; C. Male terminalia; D. Female cibarium; E. Paramere; F. Spermathecae; G. Genital pump & filaments; H. Paramere.

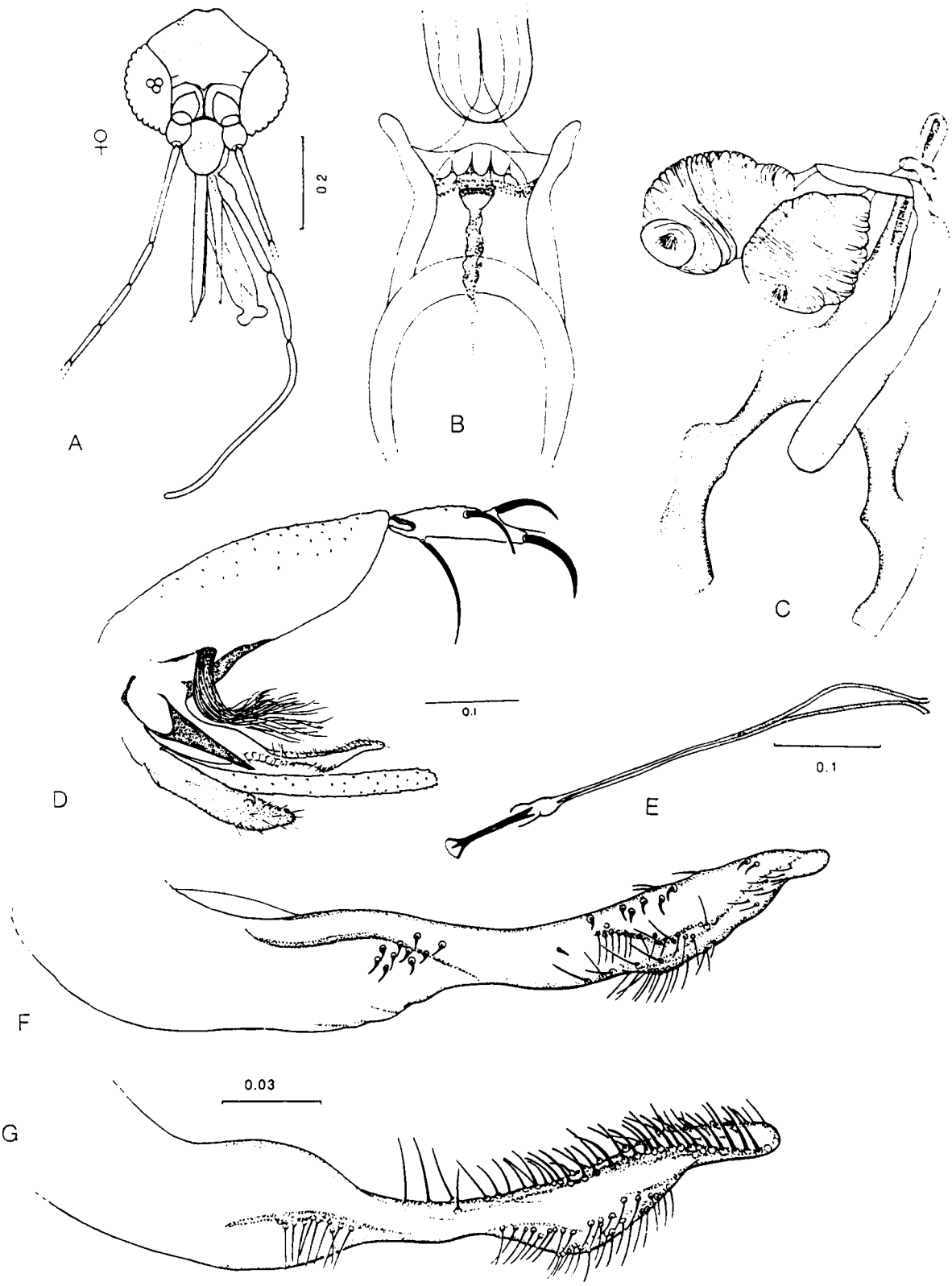



Plate 15-11

Lutzomyia sauroida. A. Female head; B. Female cibarium; C. Spermathecae; D. Male terminalia; E. Genital pump & filaments; F & G. Parameres, different lateral views (fig. D from Young 1979).

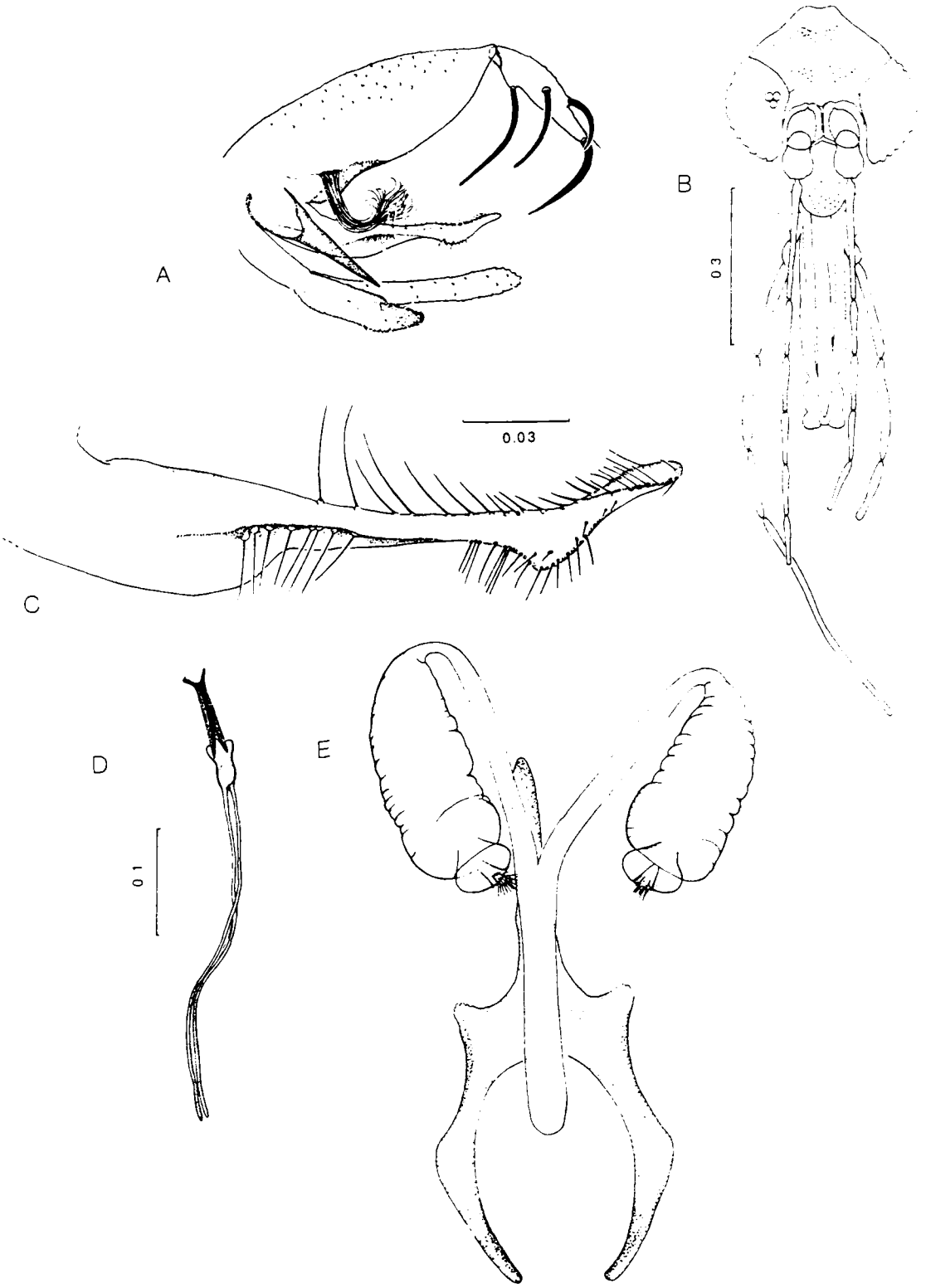



Plate 15-12

Lutzomyia townsendi. A. Male terminalia; B. Female head; C. Paramere; D. Genital pump & filaments; E. Spermathecae.

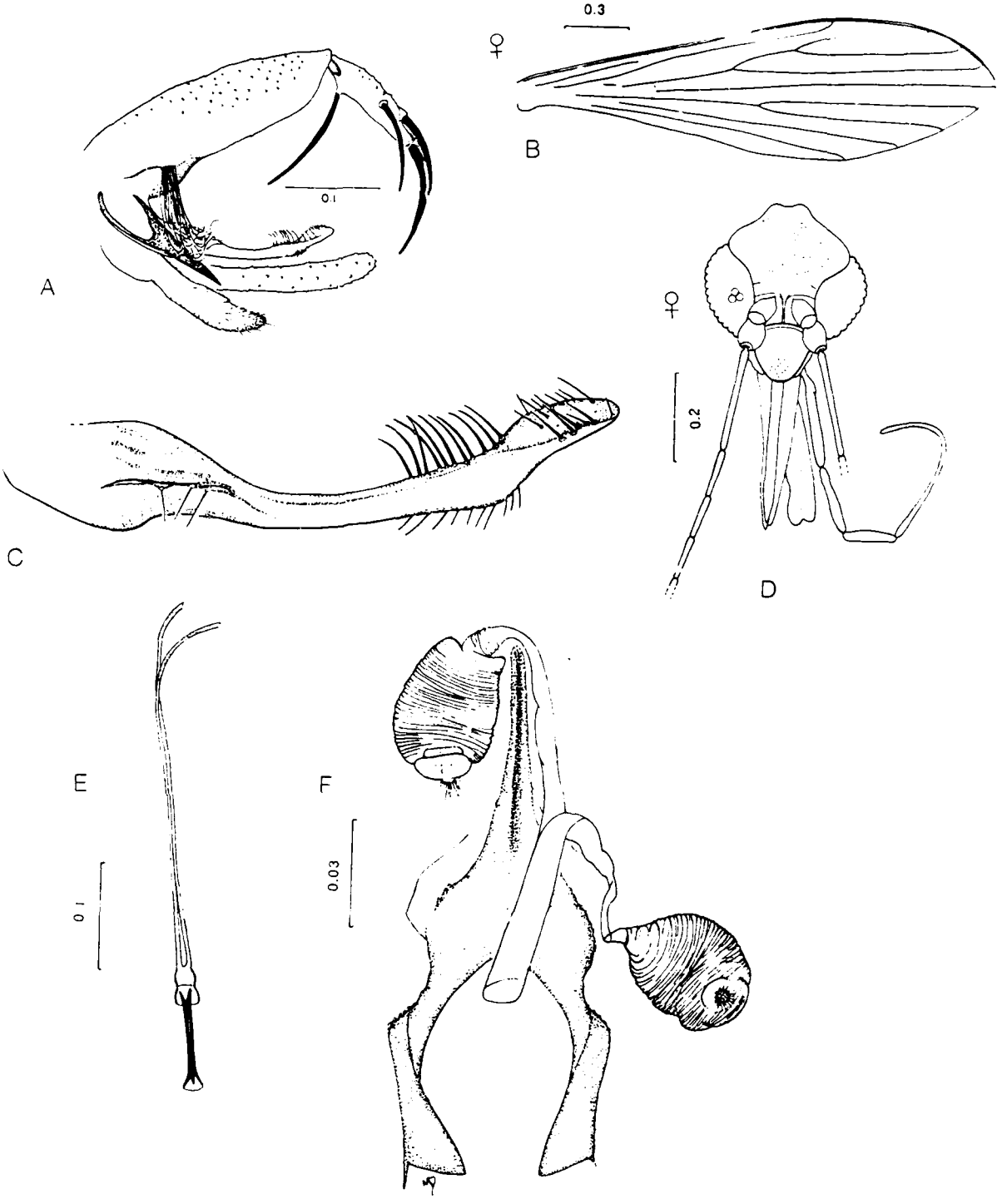



Plate 15-13

Lutzomyia quasitownsendi. A. Male terminalia; B. Female wing; C. Paramere; D. Female head; E. Genital pump & filaments; F. Spermathecae.

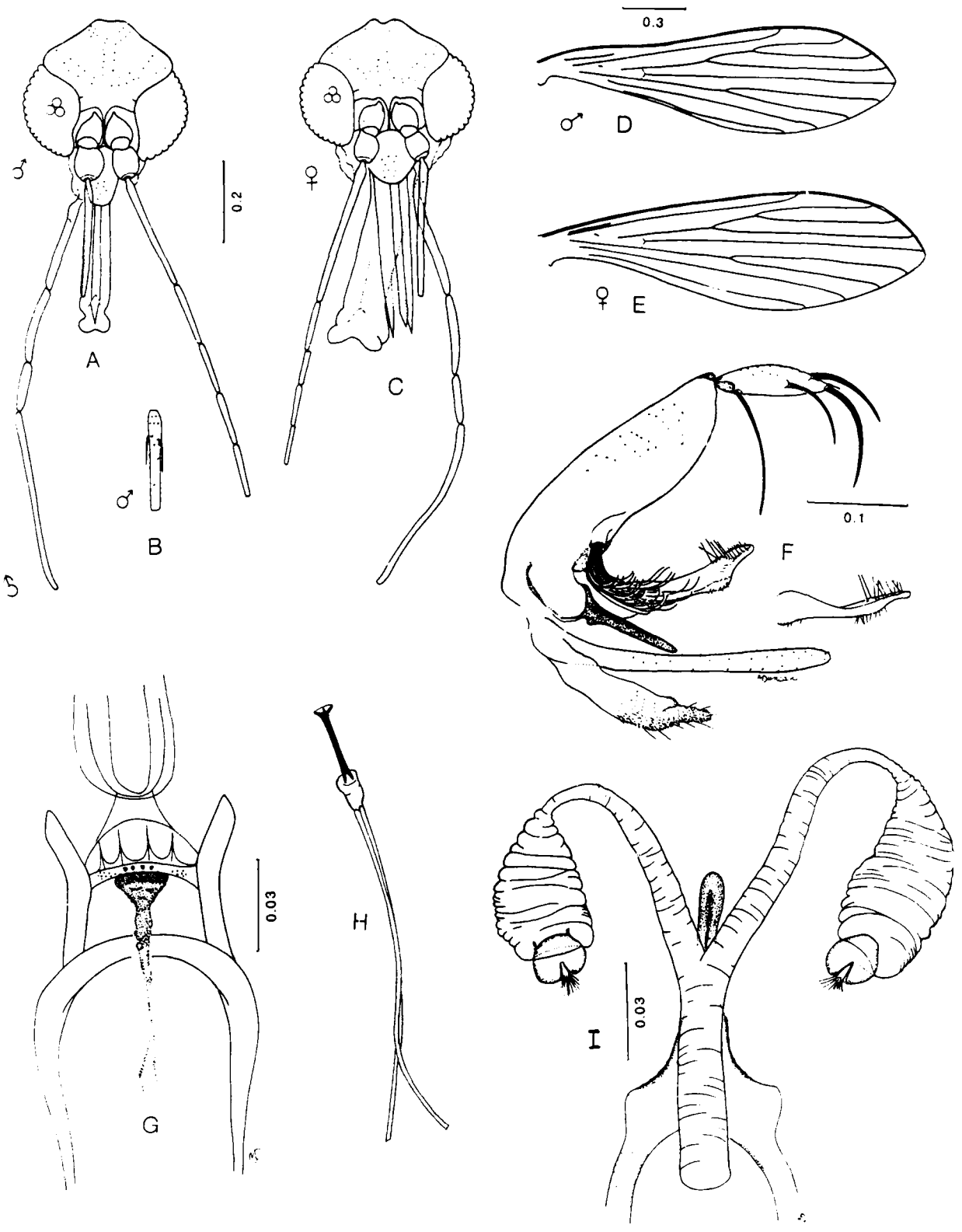



Plate 15-14

Lutzomyia youngi. A. Male head; B. Male flagellomere II; C. Female head; D. Male wing; E. Female wing; F. Male terminalia with another view of paramere; G. Female cibarium; H. Genital pump & filaments; I. Spermathecae (after Feliciangeli & Murillo 1987).

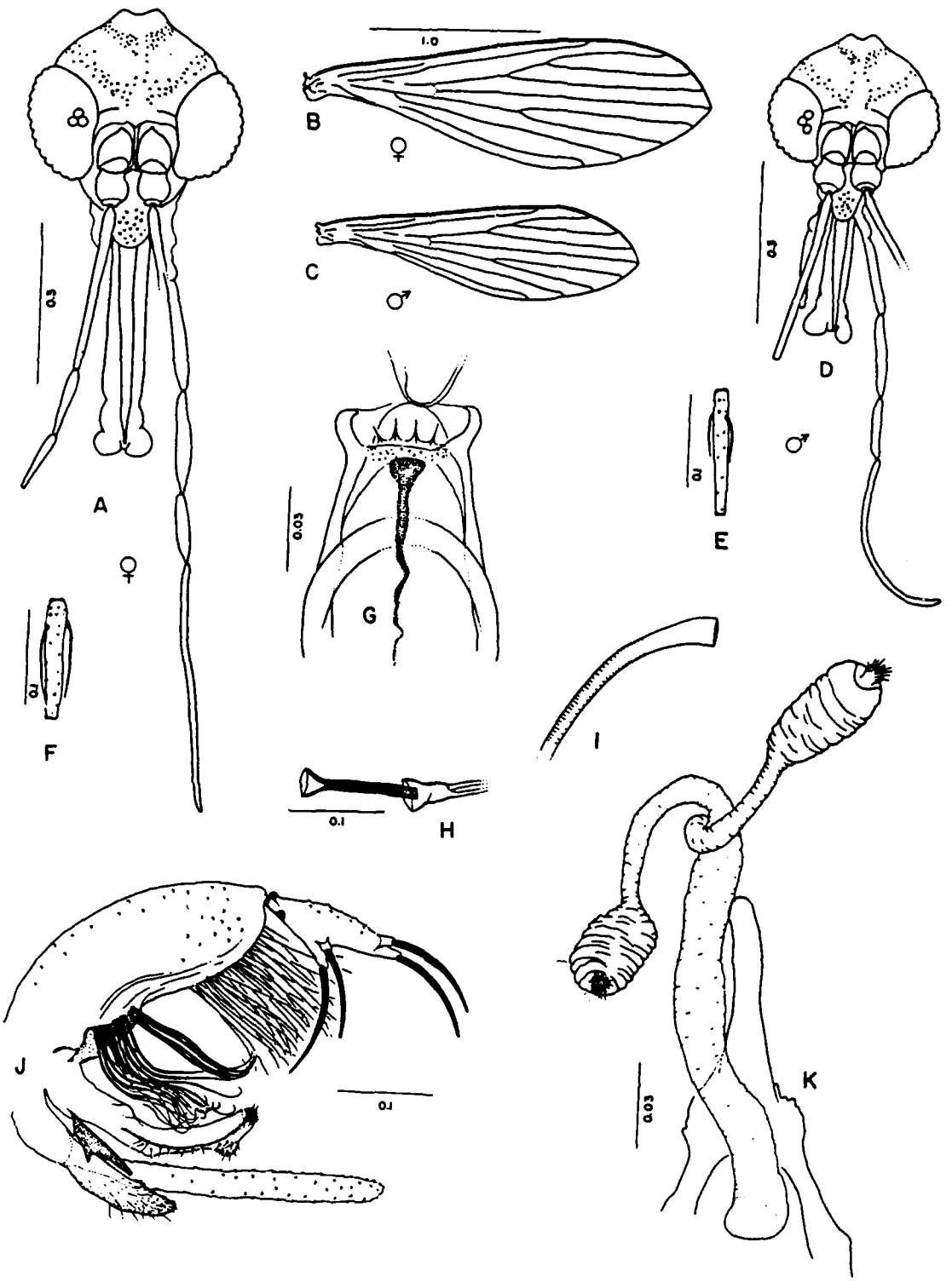



Plate 15-15

Lutzomyia moralesi. A. Female head; B. Female wing; C. Male wing; D. Male head; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Genital pump; I. Tip of genital filament; J. Male genitalia; K. Spermathecae (from Young 1979).

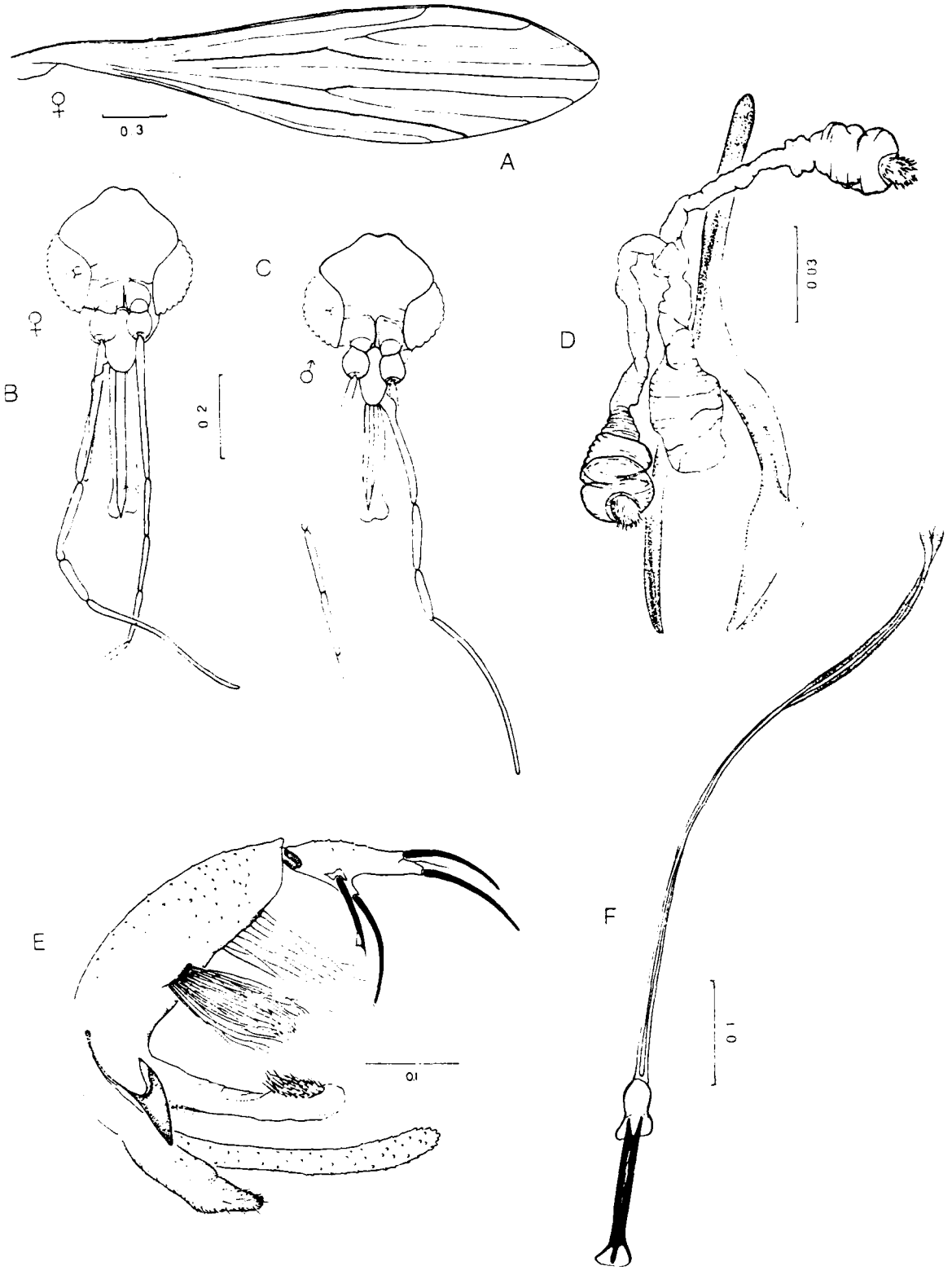



Plate 15-16

Lutzomyia andina. A. Female wing; B. Female head; C. Male head; D. Spermathecae; E. Male terminalia; F. Genital pump & filaments.

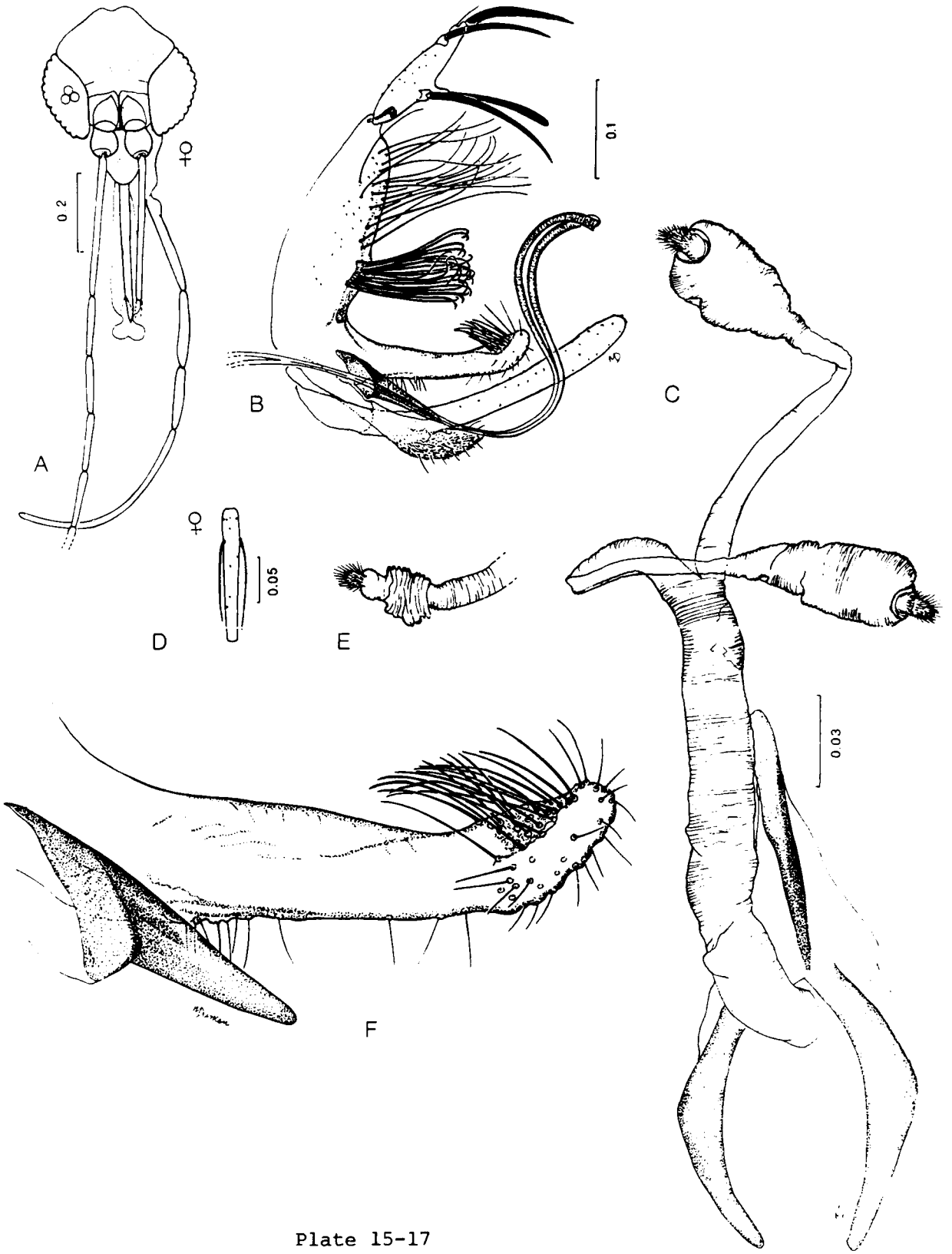



Plate 15-17

Lutzomyia aulari. A. Female head; B. Male terminalia; C. Spermathecae; D. Female flagellomere II; E. Spermatheca, contracted; F. Paramere.

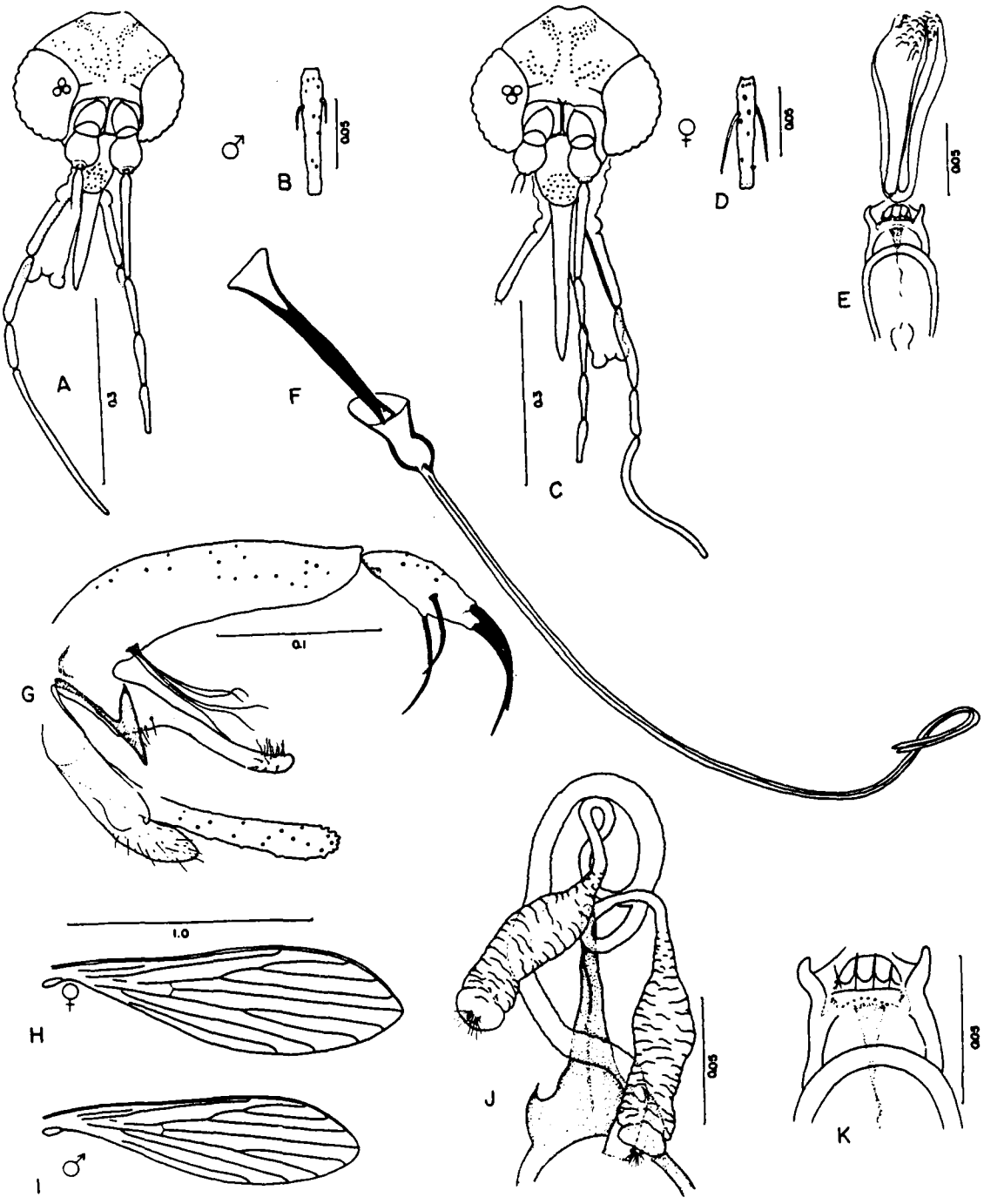



Plate 15-18

Lutzomyia ovallesi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male genitalia; H. Female wing; I. Male wing; J. Spermathecae; K. Female cibarium (from Young 1979).




Plate 15-19

Lutzomyia columbiana. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Female wing; H. Male wing; I. Male terminalia; J. Tips of genital filaments; K. Spermathecae; L. Paramere.

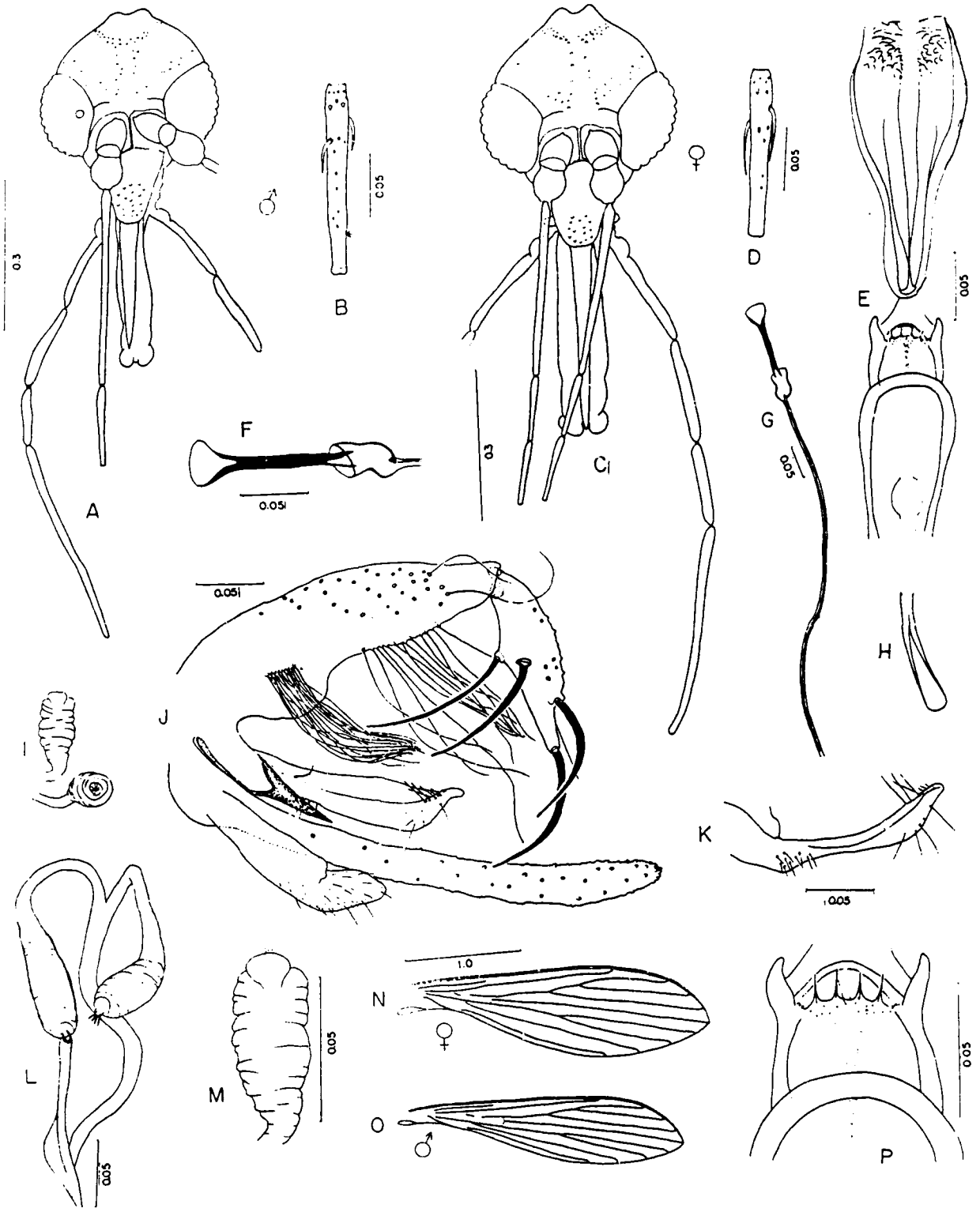



Plate 15-20

Lutzomyia verrucarum. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium and pharynx; F. Genital pump; G. Genital pump & filaments; H. Tip of genital filament; I. Spermathecae, partially contracted; J. Male terminalia; K. Paramere; L. Female spermathecae; M. Spermatheca; N. Female wing; O. Male wing; P. Female cibarium.

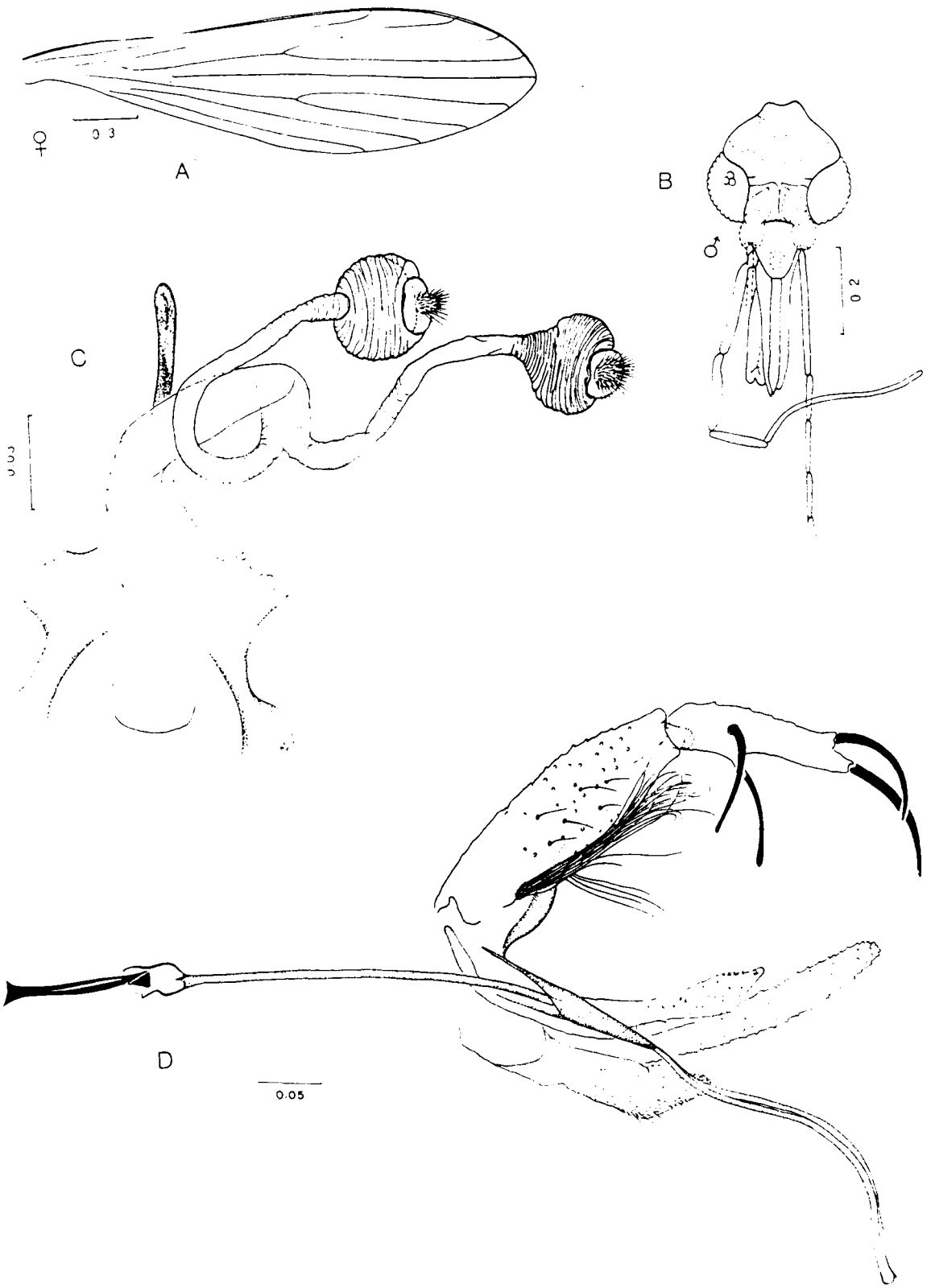



Plate 15-21

Lutzomyia disiuncta. A. Female wing; B. Male head; C. Spermathecae; D. Male terminalia (fig. D from Young 1979).

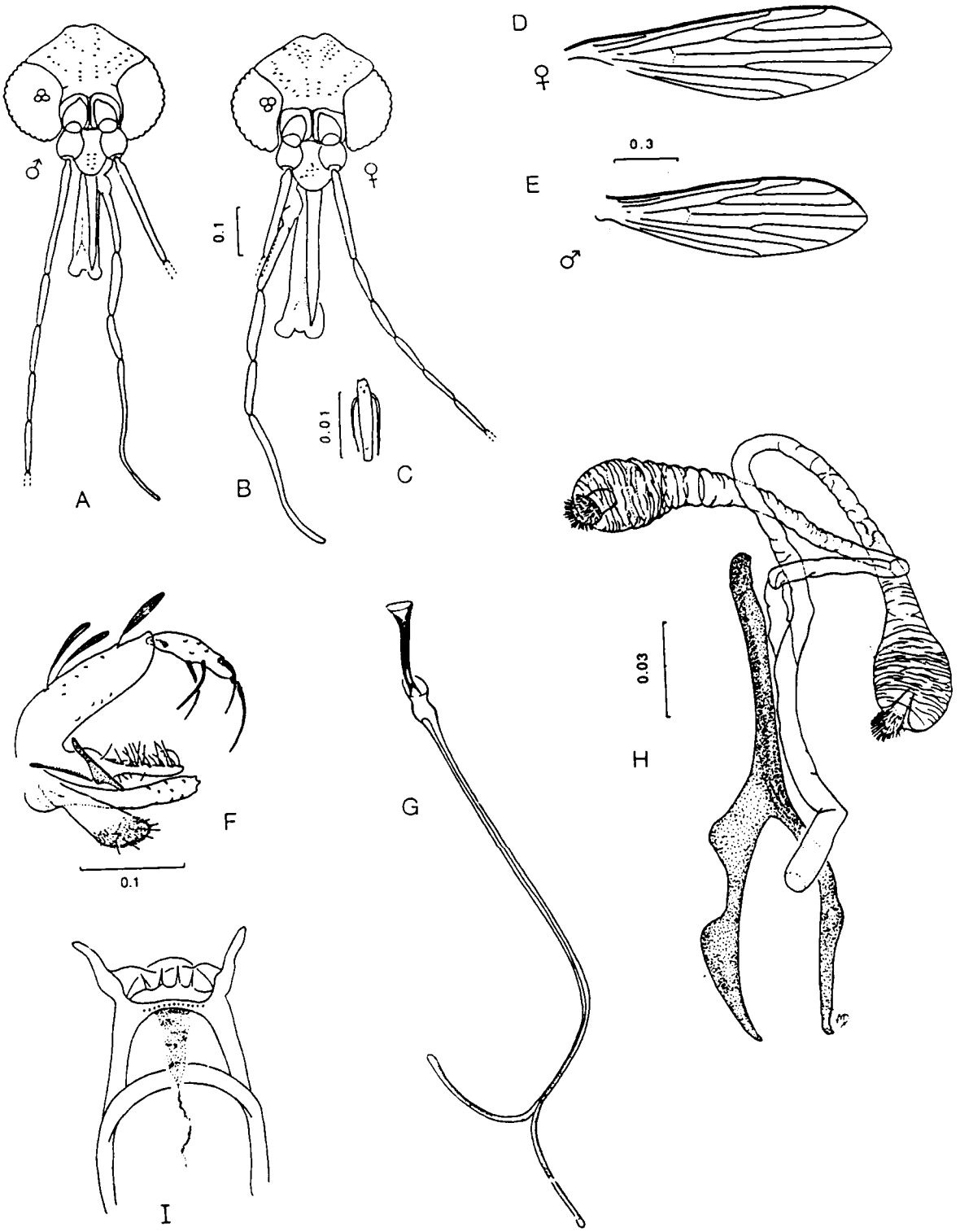



Plate 15-22

Lutzomyia nevesi. A. Male head; B. Female head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male genitalia; G. Genital pump & filaments; H. Spermathecae; I. Female cibarium.

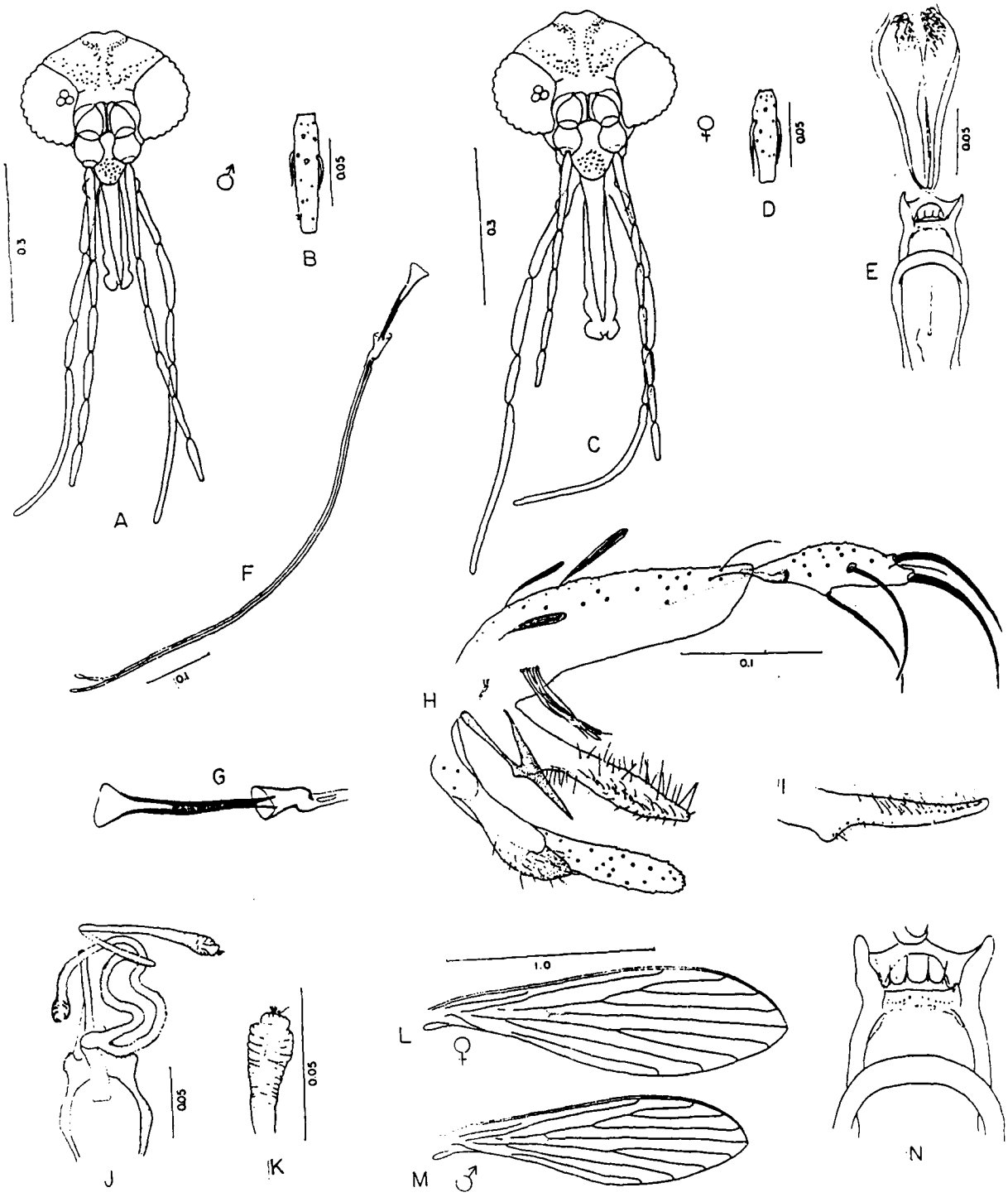



Plate 15-23

Lutzomyia evansi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Genital pump, same scale as H; H. Male genitalia; I. Paramere, outer aspect; J. Spermathecae; K. Body of spermatheca; L. Female wing; M. Male wing; N. Female cibarium. (from Young 1979).

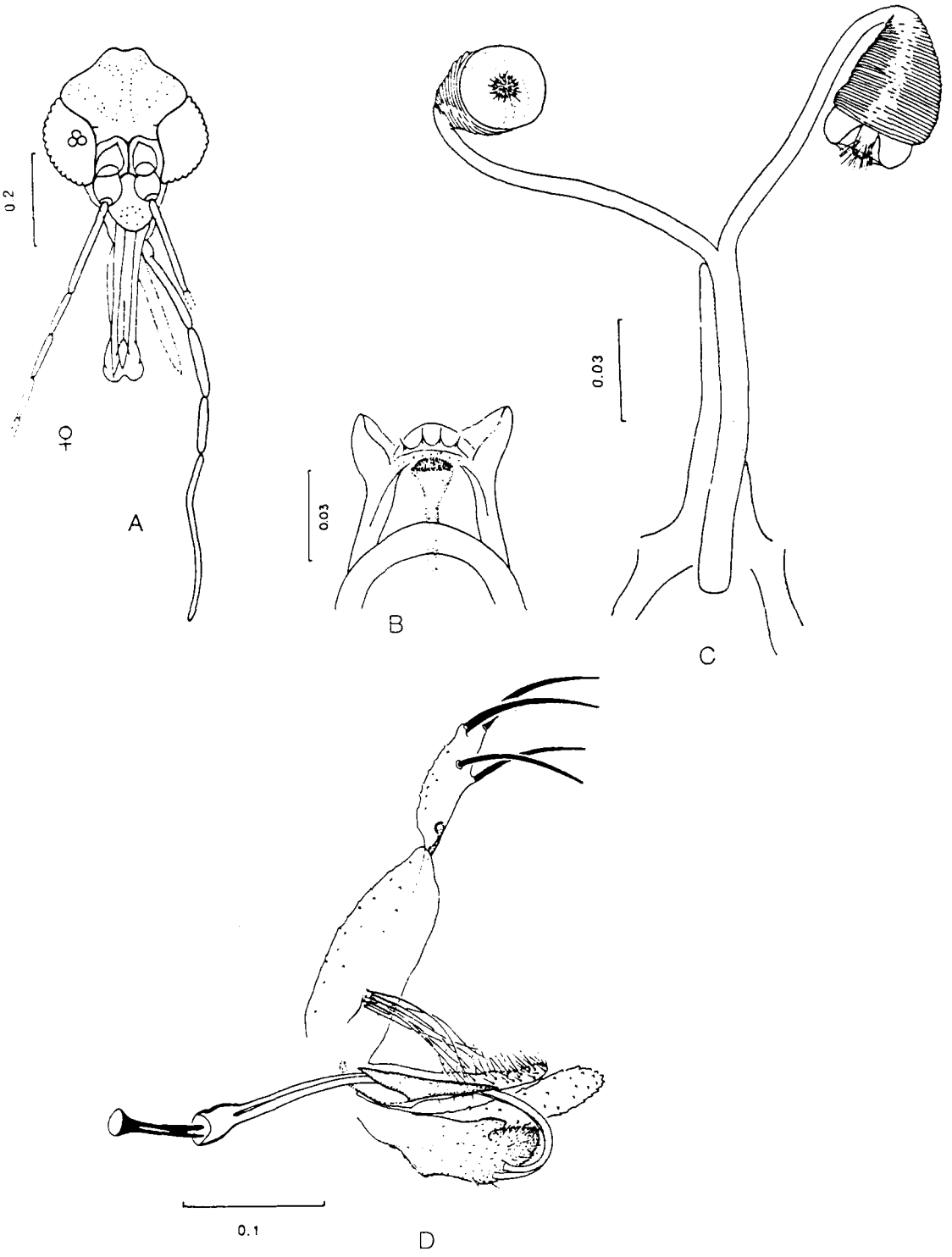



Plate 15-24

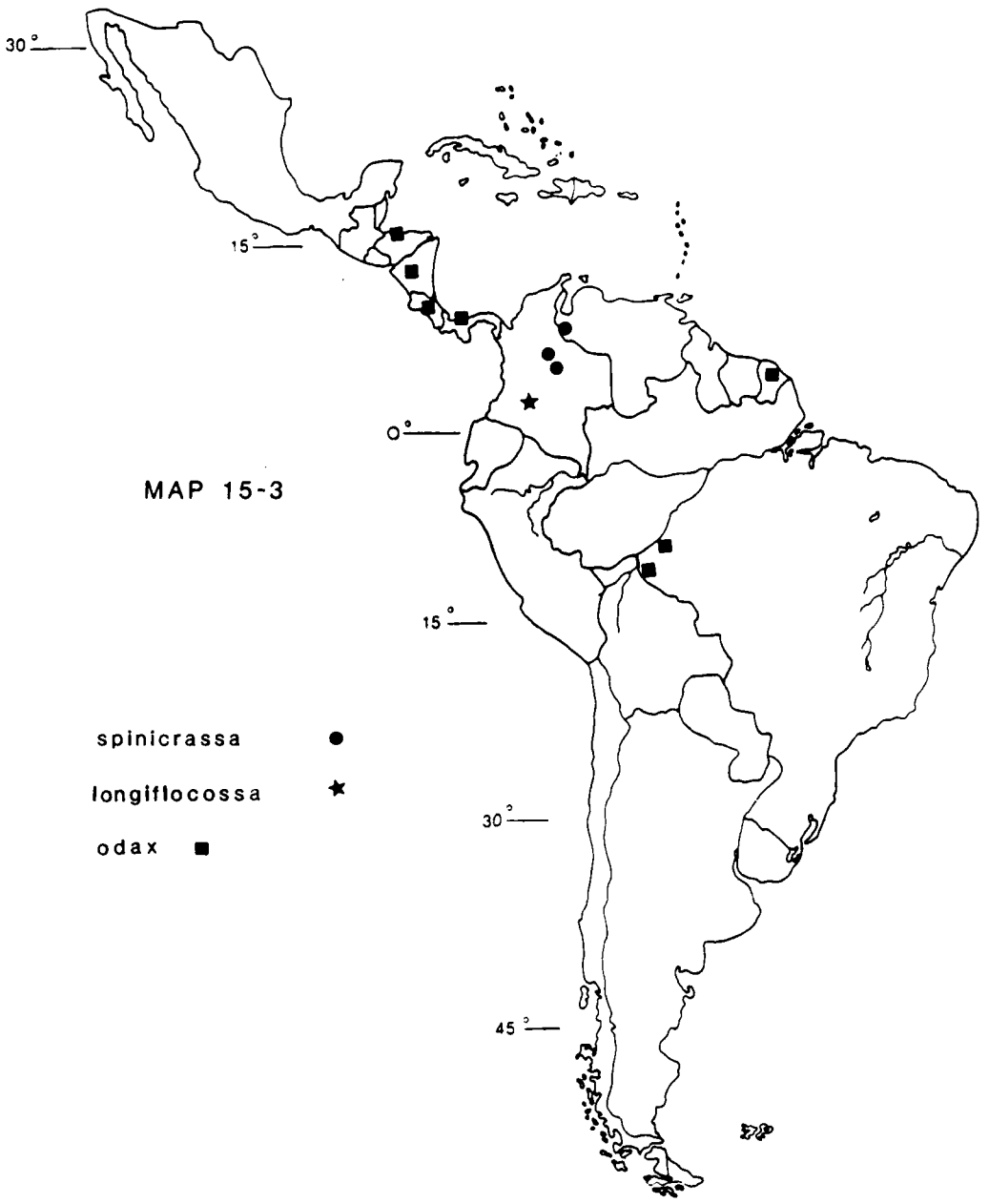
Lutzomyia nuneztovari. A. Female head; B. Female cibarium; C. Spermathecae; D. Male terminalia (figs. B & D from Young 1979).




MAP 15-1




MAP 15-2




MAP 15-3




MAP 15-4


30°
15°
0°
15°
30°
45°
MAP 15-5
moralesi
quasitownsendi
amilcari




MAP 15-6




MAP 15-7

ovallesi ✱




MAP 15-8




MAP 15-9




MAP 15-10

evansi ✱

L. ( verrucarum group ) n.sp. #2 ●

## 16. Lutzomyia Subgenus Coromyia Barretto

Lutzomyia subgenus Coromyia Barretto 1962: 97 (type species: Phlebotomus vespertilionis by orig. designation). Forattini 1971a: 101; 1973: 273 (in part, defined). Martins et al. 1978: 88.

Lutzomyia subgenus Dampfomyia (in part): Forattini 1971a: 100; 1973: 329.

Lutzomyia species group vespertilionis Theodor 1965: 183. Lewis et al. 1977: 325. Young 1979: 88.

Identification. Coloration pale to light brown. Antennal ascoids simple. Palpomere 5 usually longer than palps. 3 + 4. ♀ cibarium with 4 horizontal teeth; variable number of vertical teeth; complete arch. Pharynx unarmed. Spermathecae sac-like (vespertilionis complex) or highly modified (deleoni complex). ♂ genitalia. Coxite with persistent setae at base. Style with 2-4 spines & small subterminal seta; other small setae may be present. Parameres simple, without lateral, ventral or dorsal arms. Lateral lobes markedly inflated.

Medical Importance. Unknown; females feed on bats and other small mammals. There are scanty reports of man biting behavior.

### Key to the males of the subgenus Coromyia

1. Style with 3-4 strong spines. Paramere with acute ventral projection (deleoni complex). ..... 2

Style with 2 strong spines. Paramere lacking acute ventral projection (vespertilionis complex). ..... 4

2. Style with 3 strong spines. ..... ..... L. vesicifera (Pl. 16-1)
   Style with 4 strong spines. ..... 3

3. Paramere apically clubbed. ..... L. zeledoni (Pl. 16-2)
   Paramere otherwise, relatively slender. ..... L. deleoni (Pl. 16-2)

4. Genital filaments 3X length of genital pump or longer. Style lacking subterminal seta but with small basal & median setae. ..... L. viriosa (Pl. 16-3)
   Genital filaments shorter than 3X length of pump. Style with subterminal seta & small basal seta. ..... 5

5. Style with median spine inserted at middle of structure. ..... L. steatopyga (Pl. 16-3)
   Style with corresponding spine inserted well beyond middle of structure. ..... 6

6. Paramere with dorsal setae restricted to distal third of structure. ..... 7
   Paramere with dorsal setae covering distal half or more of structure. ..... L. vespertilionis (Pl. 16-4)

7. Style with spines inserted close together; distance between them subequal to 3X diameter of terminal spine. .....
..... L. isovespertilionis (Pl. 16-4)
Style with spines will separated, distance between them 4 or more times width of terminal spine. ..... 8

8. Lateral lobe length less than 4X maximum width. .. L. disneyi (Pl. 16-5)
Lateral lobe lenght greater than 6X maximum width.
..... L. beltrani (Pl. 16-5)

Key to the females of the subgenus Coromyia*

1. Spermathecae with large, bladder-like lateral expansion (series deleoni). ..... L. deleoni (Pl. 16-2)
L. vesicifera
L. zeledoni
Spermathecae otherwise; wrinkled, weakly annulated, sac-like or barrel-shaped. ..... 2

2. Individual & common sperm ducts slender, about subequal in length; individual ducts longer than spermathecae. ..... L. virosa (Pl. 16-3)
Individual sperm ducts shorter than common ducts, or spermathecae... 3

*From Fairchild & Hertig (1958).

3. Common sperm duct broad, not more than 2X as long as wide.

..... L. beltrani (Pl. 16-5)

L. steatopyga (Pl. 16-3)

L. disneyi

Common sperm duct more slender, at least 3X as long as wide.

..... L. vespertilionis (Pl. 16-4)

L. isovespertilionis

Lutzomyia (Coromyia) vesicifera (Fairchild & Hertig)

Plate 16-1

Phlebotomus vesiciferus Fairchild & Hertig 1947b: 620 (♂, ♀, Cruces Trail, Panama Canal Zone); 1958a: 510 (refs., ♀ fig.).

Lutzomyia vesicifera: Barretto 1962: 97. Theodor 1965: 184. Forattini 1973: 333 (♂, ♀ figs., tax.). Martins et al. 1978: 92 (refs., ♂, ♀ figs.). Zeledón & Murillo 1983: 280 (Nicaragua). Christensen et al. 1983: 466 (Panama). Young & Murillo 1984: 712 (♂ fig.). Murillo & Zeledón 1985: 84 (♂, ♀ figs., Costa Rica).

Distribution (Map 16-1). Nicaragua (Zeledón & Murillo 1983); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978).

Lutzomyia (Coromyia) zeledoni Young & Murillo

Plate 16-2

Lutzomyia zeldoni Young & Murillo 1984: 711 (♂, Brasilito, Guanacaste, Costa Rica). Murillo & Zeledón 1985: 87 (♂ fig., Costa Rica). Le Pont et al. 1987: 273 (♀ descript., Nicaragua).

Distribution (Map 16-2). Costa Rica; Honduras (Young & Murillo 1984); Nicaragua (Le Pont et al. 1987).

Remarks. Females have been captured with males of L. zeledoni at the type locality and in Nicaragua. It is not possible to distinguish females of this species from those of L. deleoni or L. vesicifera.

Lutzomyia (Coromyia) deleoni (Fairchild & Hertig)

Plate 16-2

Phlebotomus deleoni Fairchild & Hertig 1947b: 622 (♂, ♀, Peten, Guatemala); 1958a: 510 (full refs., keyed).

Lutzomyia deleoni: Barretto 1962: 97 (listed). Theodor 1965: 184 (♀ fig.). Williams 1970b: 333 (coll. data, Belize); 1976b: 603 (in caves, Belize); 1976c: 616 (negative for flagellates, Belize). Forattini 1973: 329 (figs.). Martins et al. 1978: 92 (refs., dist.). Murillo & Zeledón 1985: 84 (♂, ♀ figs., Costa Rica). Porter et al. 1987: 930 (human bait collection, Guatemala).

Distribution (Map 16-3). Mexico; Guatemala; Belize; Honduras; El Salvador (Martins et al. 1978); Costa Rica (Murillo & Zeledón 1985).

Lutzomyia (Coromyia) viriosa (Fairchild & Hertig)

Plate 16-3

Phlebotomus viriosus Fairchild & Hertig 1958a: 510 (♂, ♀, Almirante, Bocas del Toro, Panama).

Lutzomyia viriosa: Barretto 1962: 97 (listed). Theodor 1965: 184 (listed). Forattini 1973: 291 (♂, ♀ figs., tax.). Martins et al. 1978: 91 (refs., dist.). Christensen et al. 1983: 466 (Panama). Murillo & Zeledón 1985: 82 (♂, ♀ figs., Costa Rica).

Distribution (Map 16-4). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978).

Lutzomyia (Coromyia) steatopyga (Fairchild & Hertig)

Plate 16-3

Phlebotomus steatopygus Fairchild & Hertig 1958a: 512 (♂, ♀, Palenque, Chiapas, Mexico).

Lutzomyia steatopyga: Barretto 1962: 97 (listed). Theodor 1965: 184 (listed). Forattini 1973: 289 (♂ fig., tax.). Williams 1976a: 595 (cf. to beltrani, Belize form). Martins et al. 1978: 91 (refs., dist.).

Distribution (Map 16-1). Mexico (type locality).

Remarks. This species was reported in Belize by Williams (1970), who later (1976a) pointed out differences between Belize males and those from Mexico.

## Lutzomyia (Coromyia) vespertilionis (Fairchild & Hertig)

Plate 16-4

Phlebotomus vespertilionis Fairchild & Hertig 1947b: 617 (♂, ♀, Cerro Campana, Panama); 1958a: 514 (redescript. ♂, fig.).

Lutzomyia vespertilionis: Barretto 1962: 97 (listed). Theodor 1965: 184 (♂, ♀ figs.). Martins et al. 1978: 91 (refs., dist., ♂, ♀ figs.). Young 1979: 90 (figs., refs., dist.). Christensen & Herrer 1980b: 523 (feeding habits). Zeledón & Murillo 1983: 280 (Nicaragua). Christensen et al. 1983: 466 (Panama). Young & Rogers 1984: 599 (Ecuador). Murillo & Zeledón 1985: 81 (♂, ♀ figs., Costa Rica).

Distribution (Map 16-5). Costa Rica (Murillo & Zeledón 1985); Panama; Colombia; Ecuador (Martins et al. 1978; Young 1979).

Remarks. As the specific name indicates, L. vespertilionis is associated with bats and probably serves as an important vector of Trypanosoma throughout its range (Christensen & Herrer 1975b).

## Lutzomyia (Coromyia) isovespertilionis (Fairchild & Hertig)

Plate 16-4

Phlebotomus isovespertilionis Fairchild & Hertig 1958a: 516 (♂, ♀, Panama Canal Zone).

Lutzomyia isovespertilionis: Barretto 1962: 97 (listed). Forattini 1973: 287 (♂ fig., tax.). Christensen et al. 1983: 466 (Panama). Martins et al. 1978: 90 (refs., dist.). Young 1979: 88 (♂ fig., refs., dist.). Murillo & Zeledón 1985: 78 (♂ fig., Costa Rica).

Distribution (Map 16-2). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979).

Remarks. As discussed by Fairchild & Hertig (1958a), the adults of this and L. vespertilionis are structurally similar. Hanson (1968) could not detect differences between the immature stages of the species.

## Lutzomyia (Coromyia) disneyi Williams

Plate 16-5

Lutzomyia disneyi Williams 1987: 525 (♂, ♀, San Antomio, Cayo District, Belize).

Lutzomyia beltrani (Belize form): Williams 1976a: 595 (tax., figs.); 1976b: 601; 1976c: 615 (natural flagellate infections).

Distribution (Map 16-1). Belize (Williams 1976b); Guatemala (2 ♂♂, 3 ♀♀, Coop. Tanhoc, Poptun, Peten, June 1981, C.H. Porter).

Remarks. This species is probably a vector of Trypanosoma leonidasdeansi, a blood parasite of bats, in Belize. Williams (1976b,c) determined that L. disneyi was the most common Lutzomyia spp. found in limestone caves in that country.

## Lutzomyia (Coromyia) beltrani (Vargas & Najera)

Plate 16-5

Phlebotomus beltrani Vargas & Najera 1951b: 101 (♂, San Andres Tuxtla, Veracruz, Mexico). Fairchild & Hertig 1958a: 512 (♂, ♀, redescript., figs.).

Lutzomyia beltrani: Barretto 1962: 97 (listed). Theodor 1965: 184 (listed). Forattini 1973: 283 (♂, ♀ figs., tax.). Williams 1976a: 595 (variant form, Belize). Martins et al. 1978: 90 (dist. refs.).

Distribution (Map 16-4). Mexico; Honduras (Fairchild & Hertig 1958a).

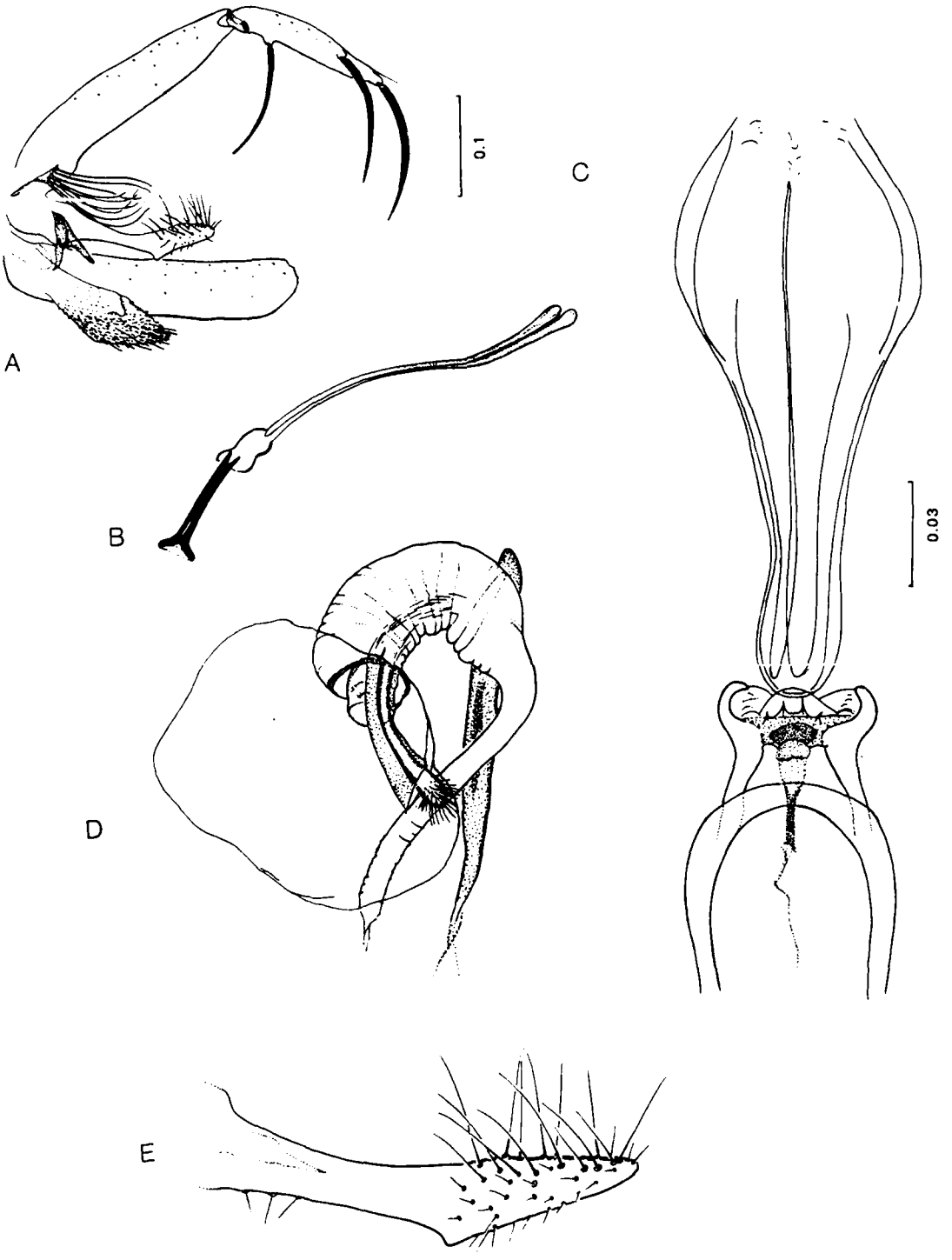



Plate 16-1

Lutzomyia vesicifera. A. Male terminalia; B. Genital pump & filaments; C. Female cibarium & pharynx; D. Spermatheca, other one not shown; E. Paramere.

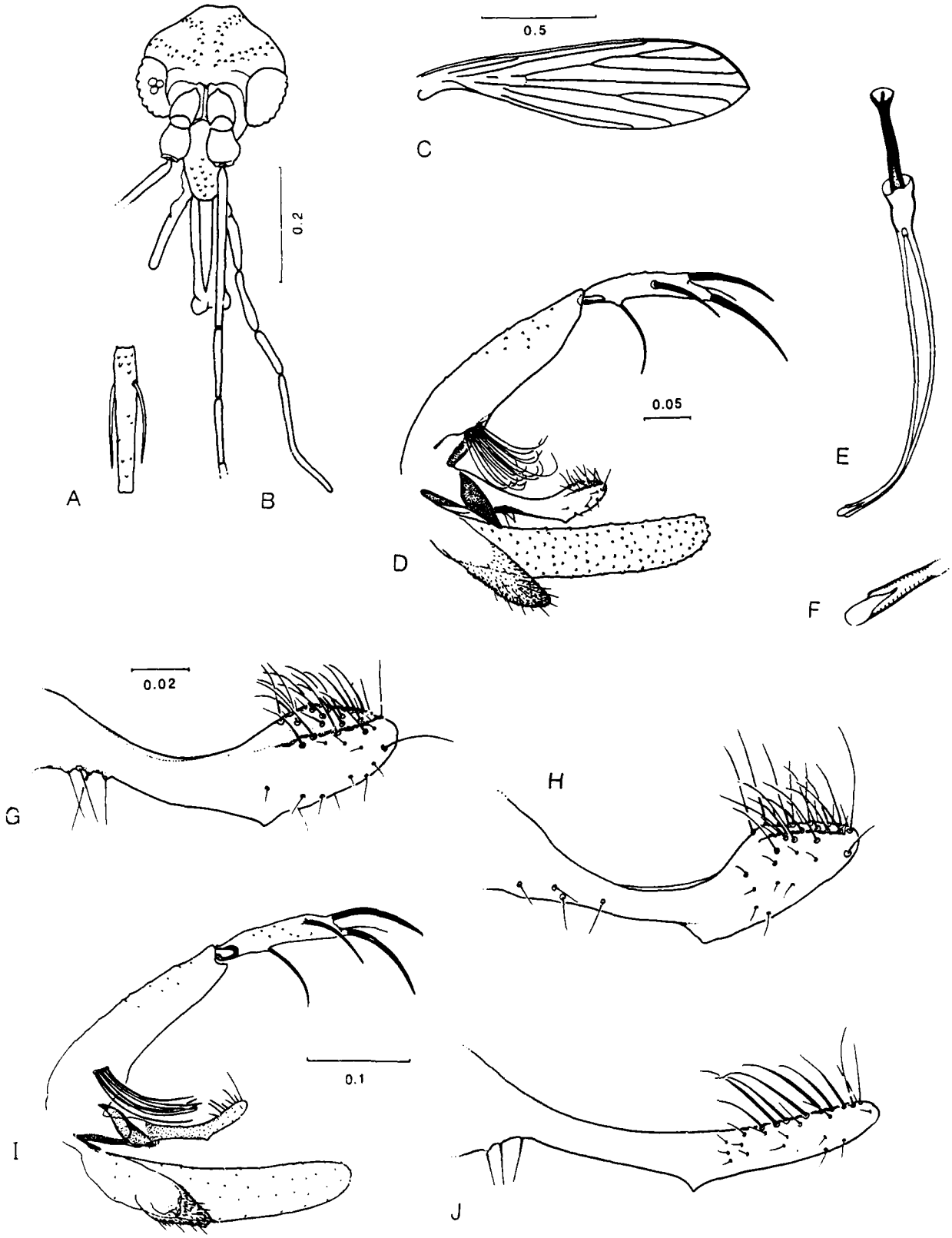



Plate 16-2

Lutzomyia zeledoni. A. Male flagellomere II; B. Male head; C. Male wing; D. Male terminalia; E. Genital pump & filaments; F. Tip of genital filament; G. Paramere; H. Paramere (from Young & Murillo 1984).

Lutzomyia deleoni. I. Male terminalia; J. Paramere (fig. J from Young & Murillo 1984).

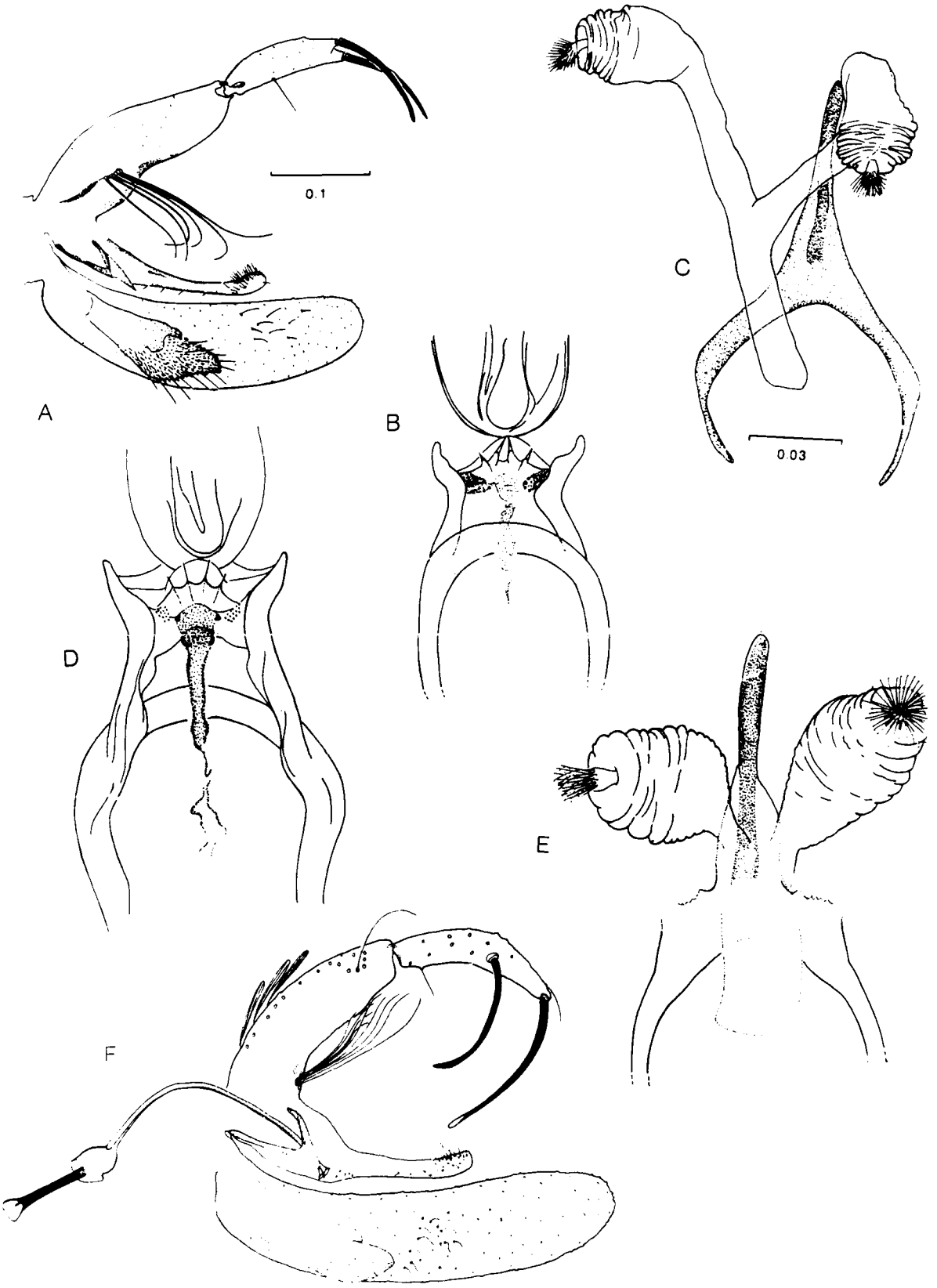



Plate 16-3

Lutzomyia viriosa. A. Male terminalia; C. Spermathecae; D. Female cibarium.

Lutzomyia steatopyga. B. Female cibarium; E. Spermathecae; F. Male terminalia (fig. E after Fairchild & Hertig 1958a).

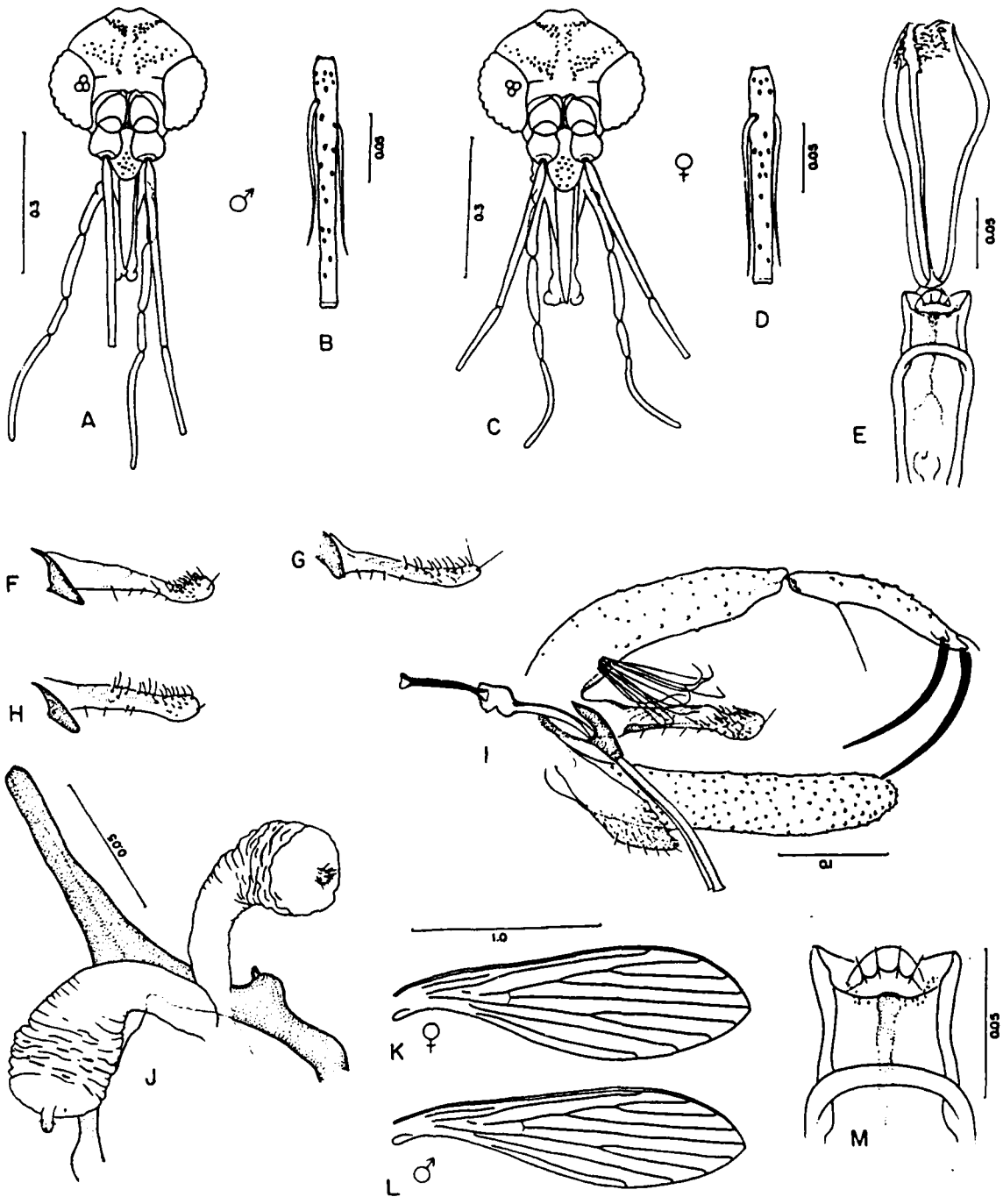



Plate 16-4

Lutzomyia vespertilionis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium; G. Paramere; H. Paramere; I. Male terminalia; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium. (From Young 1979).

Lutzomyia isovespertilionis. F. Paramere (From Young 1979)

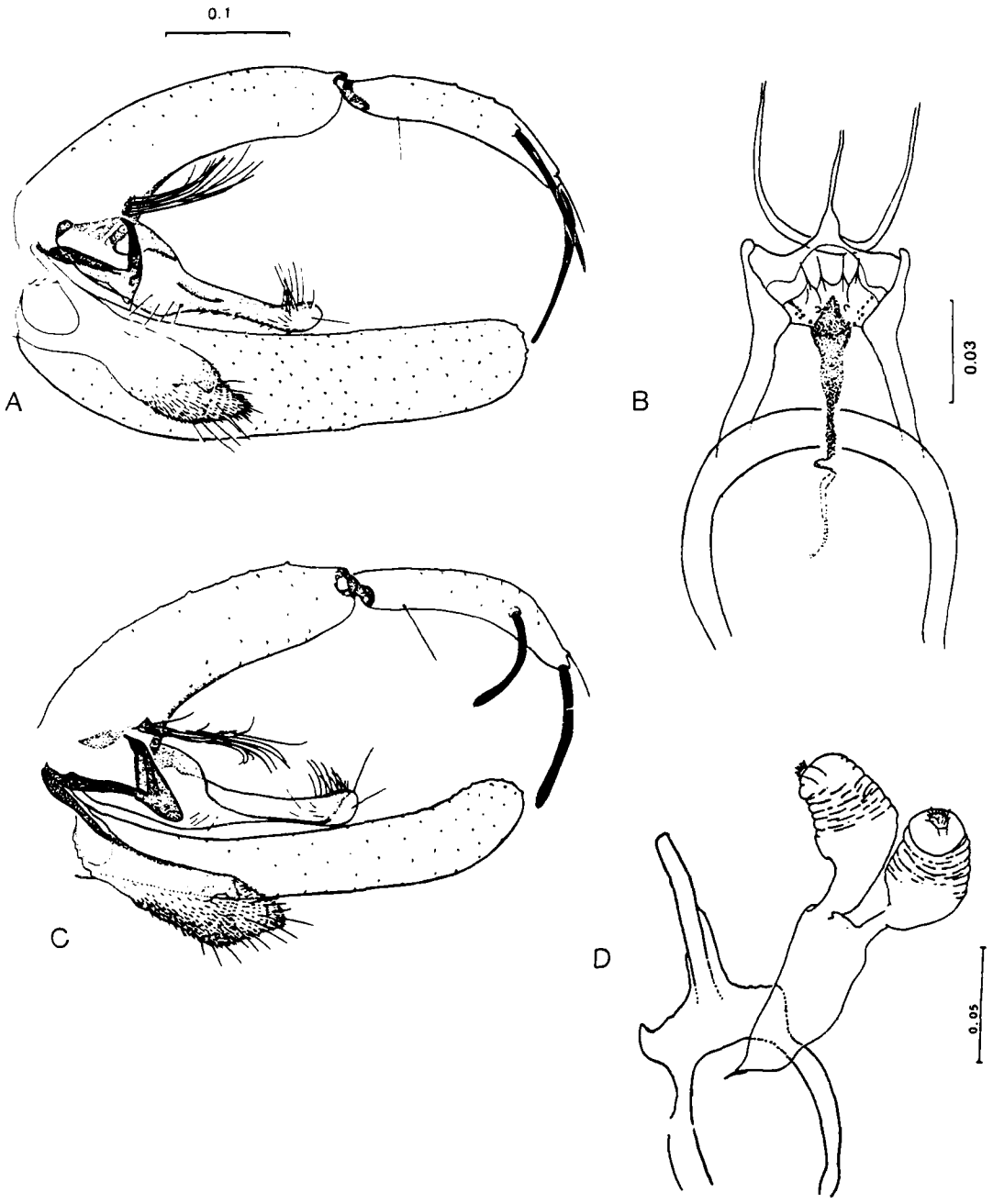



Plate 16-5

Lutzomyia beltrani. A. Male terminalia; B. Female cibarium; D. Spermathecae (from Fairchild & Hertig 1958a).

Lutzomyia disneyi. C. Male terminalia.




MAP 16-1




MAP 16-2




MAP 16-3




MAP 16-4




MAP 16-5

vespertilionis ✱

## 17. LUTZOMYIA SPECIES GROUP DELPOZOI

Lutzomyia species group delpozoi Lewis et al. 1977: 325. Martins et al. 1978: 155.

Identification. Coloration dusky. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with two blade-like horizontal teeth & well developed lateral teeth; cibarial arch complete & prominent. ♀ pharynx unarmed. Spermathecae sac-like with relatively long terminal knob. ♂ genitalia. Style with 4 strong spines (basal spine isolated) & small subterminal seta. Coxite with basal tuft of long setae; apex somewhat truncate. Parameres variable, with simple setae.

The delpozi group species share some apomorphic characters with males in the subgenus Coromyia (e.g., inflated lateral lobes of one species). The cibarial armatures resemble those of some Lutzomyia (Dampfomyia) spp. but the males of the delpozoi group have a basal coxite tuft, similar to some males in the verrucarum species group. Forattini (1971, 1973) places these species in the subgenus Pressatia but the spermathecae differ greatly.

We list three named species in this review but another species, as yet undescribed, has been discovered in Arizona, U.S.A. Structurally, the females of the three described species are indistinguishable.

Medical Importance. Unknown; females are not anthropophilic.

Key to the males of the delpozoi species group

1. Paramere relatively slender, its apex truncate.. L. inusitata (Pl. 17-2)

   Paramere broader, its apex subacute. ..... 2

2. Paramere with a ventral acute projection. ... L. piedraferroi (Pl. 17-3)

   Paramere without a ventral acute projection. .... L. delpozoi (Pl. 17-1)

## Lutzomyia delpozoi (Vargas & Najera)

Plate 17-1

Phlebotomus del-pozoi Vargas & Najera 1953a: 42 (♂, ♀, Mariscal, Chiapas, Mexico).

Lutzomyia delpozoi: Theodor 1965: 196 (♀ figs.).

Pressatia delpozoi: Forattini, 1971a: 106; 1973: 515 (figs.)

Distribution (Map 17-1). Mexico; ? Belize (Martins et al. 1978); Guatemala (3 ♂♂, Potum, Peten, 1981, C.H. Porter).

Remarks. Williams (1970b) captured a male sand fly (species D) in Belize that belongs in this species group but its specific identity was not determined. Later, Martins et al. (1978) definitely list L. delpozoi from this country.

The males from Guatemala agree with the description of L. delpozoi except that the lateral lobes are more inflated (Pl. 17-1).

## Lutzomyia inusitata (Fairchild & Hertig)

Plate 17-2

Phlebotomus inusitatus Fairchild & Hertig 1961a: 22 (♂, ♀, Ocosocoautla, Chiapas, Mexico).

Lutzomyia inusitata: Theodor 1965: 196. Martins et al. 1978: 156.

Pressatia inusitata: Forattini 1971a: 107; 1973: 517 (figs.).

Distribution (Map 17-1). Mexico (Fairchild & Hertig 1961a).

Remarks. This species is known only from two specimens, the holotype and allotype collected together on tree trunks in southern Mexico about 60 km W of Tuxtla.

## Lutzomyia piedraferroi León

Plate 17-3

Phlebotomus piedra-ferroi León 1971: 189 (♂, Piedra de los Fierros, Esquipulas, Chiquimula, Guatemala). Martins et al. 1978: 169 (listed as inadequately described).

Distribution (Map 17-1). Guatemala (León 1971; present paper).

Remarks. The holotype of L. piedraferroi, examined by us through the courtesy of C.H. Porter, has four major spines on the style rather than three as illustrated by León (1971, Fig. 5).

In addition, we studied 20 ♂♂ and 15 ♀♀ of L. piedraferroi from Finca Santa Isabel, Suchitepequez Dept., Guatemala collected by Dr. Porter in 1980 and 1981. The males closely resemble L. delpozoi but their parameres have an acute ventral projection and the basal spine on the style is nearly as large as the subterminal spines, unlike those illustrated for L. delpozoi by Vargas & Najera (1953a).

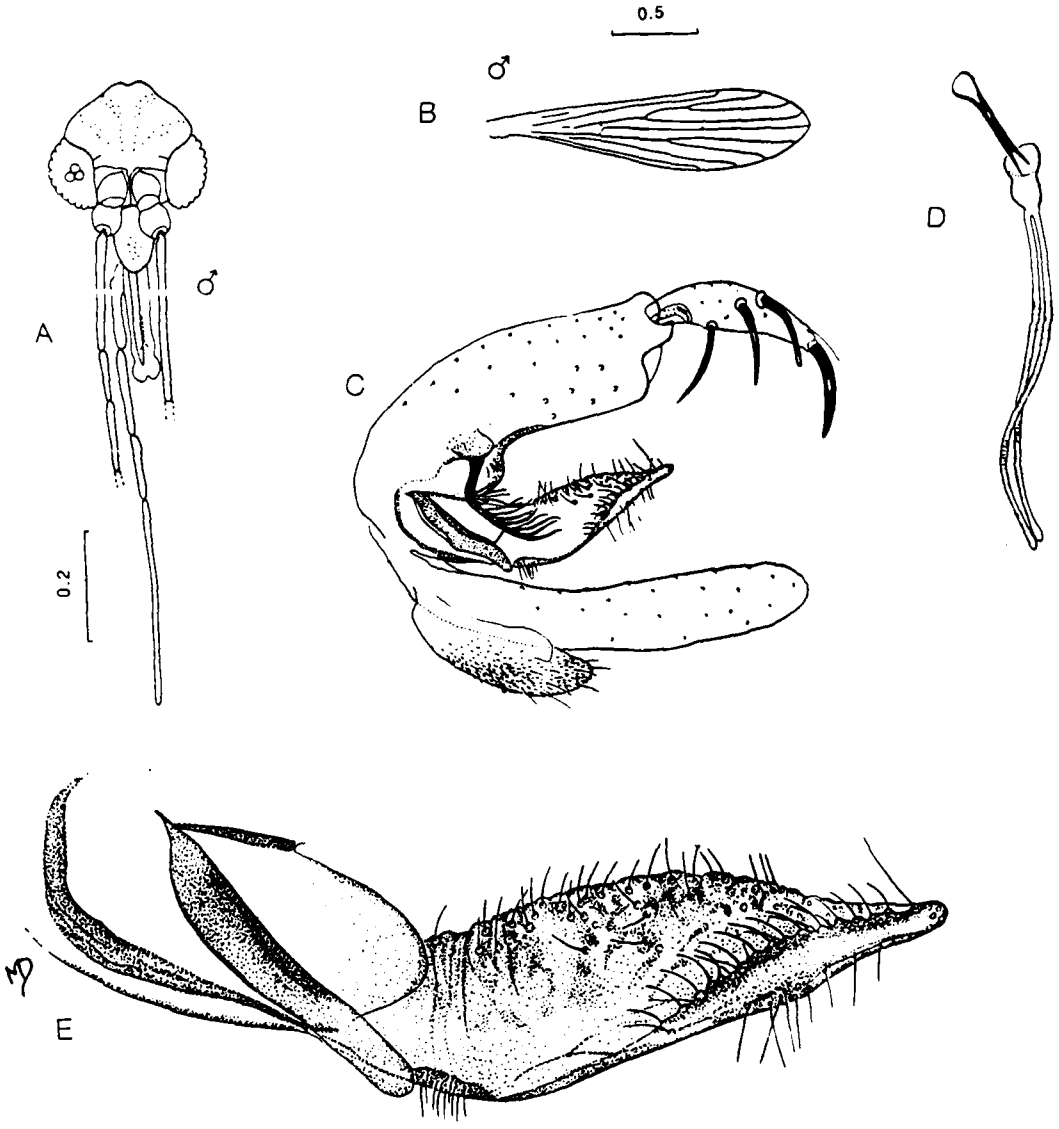



Plate 17-1

Lutzomyia delpozoi. A. Male head; B. Male wing; C. Terminalia; D. Genital pump & filaments; E. Paramere.

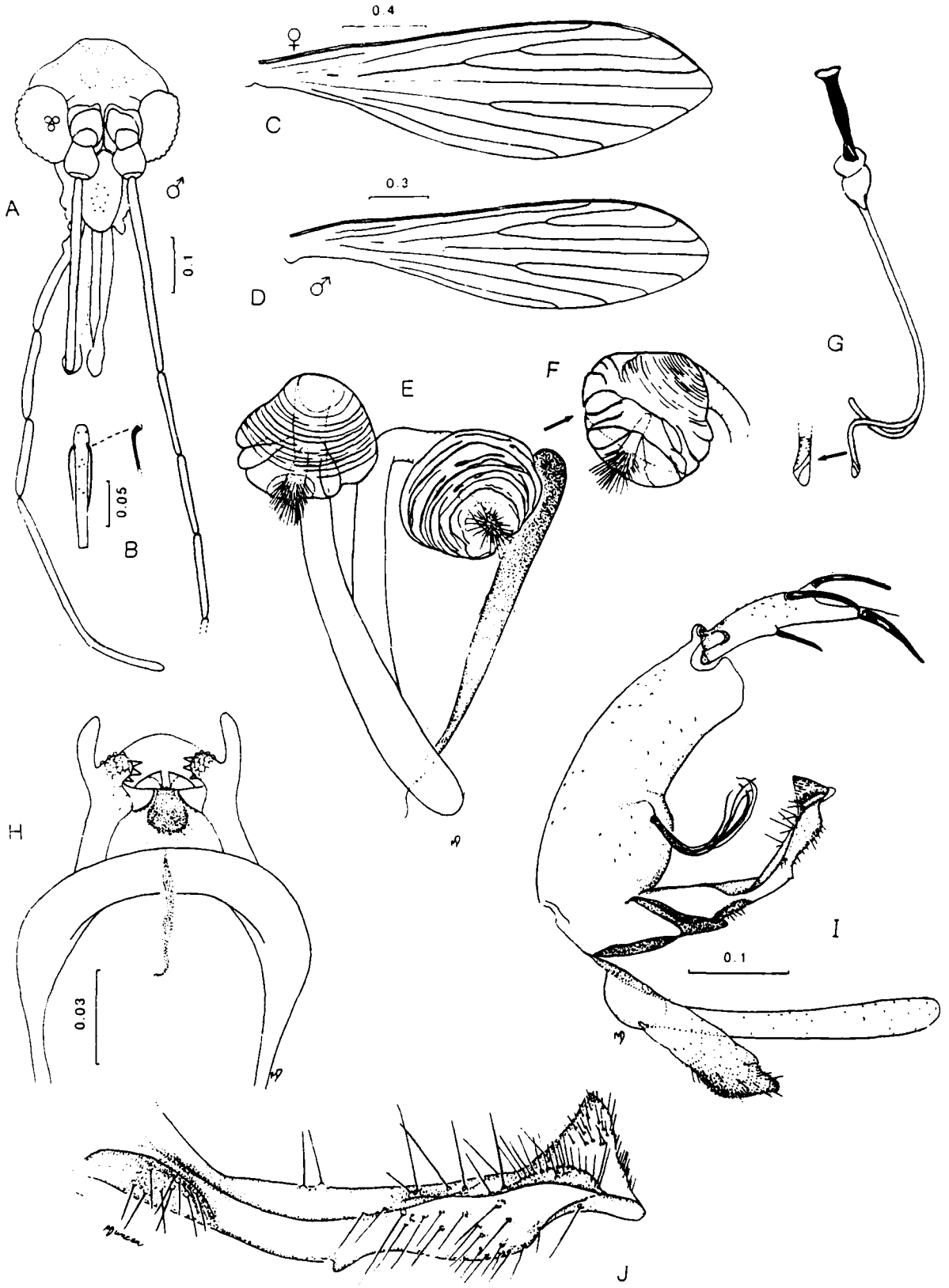



Plate 17-2

Lutzomyia inusitata. A. Male head; B. Male flagellomere II & ascoid; C. Female wing; D. Male wing; E. Spermathecae; F. Spermathecae (different aspect); G. Genital pump & filaments; H. Female cibarium; I. Male terminalia; J. Paramere.

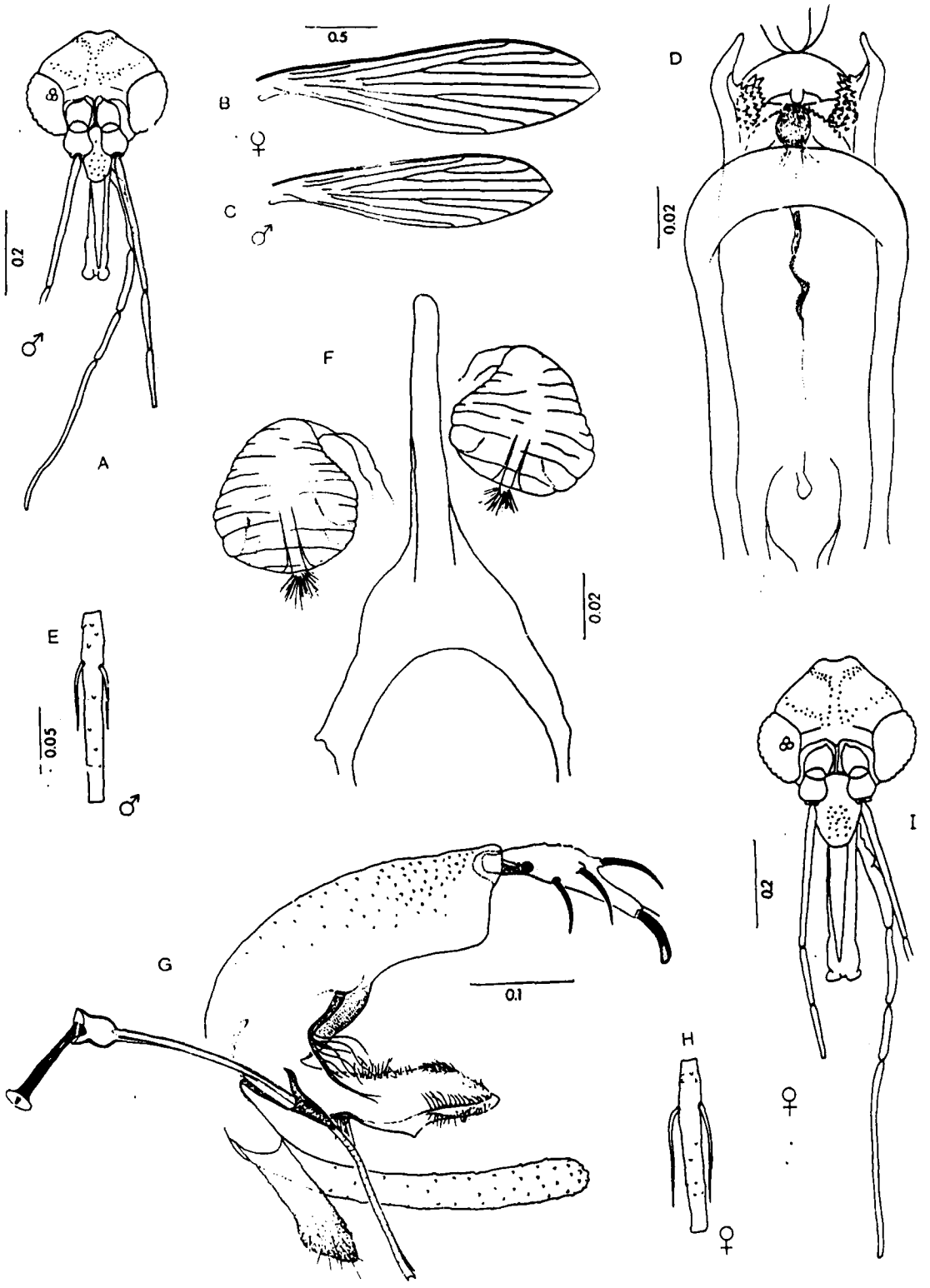



Plate 17-3

Lutzomyia piedraferroi. A. Male head; B. Female wing; C. Male wing; D. Female cibarium; E. Male flagellomere II; F. Spermathecae; G. Male terminalia & genital pump; H. Female flagellomere II; I. Female head.




MAP 17-1

## 18. Lutzomyia Subgenus Dampfomyia Addis

Lutzomyia subgenus Dampfomyia Addis 1945a: 120 (type species: Phlebotomus anthophorus Addis by orig. designation). Fairchild & Hertig 1956: 307 (review). Barretto 1962:95 (defined). Theodor 1965: 193 (defined). Martins et al. 1978: 57 (defined).

Phlebotomus subgenus Anthophorus of Leon 1971: 187.

Identification. Coloration pale to light brown. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. Eyes small. ♀ cibarium with 4-6 horizontal teeth, pointed or blade-like & complete arch. Pharynx unarmed. Spermathecae modified with bubble-like evaginations. ♂ genitalia. Coxite lacking persistent setae. Style with 3-5 spines & subterminal seta. Paramere with dorsal arm bearing setae.

The center of distribution of the Dampfomyia spp. is in the northern neotropics. One species, L. rosabali, has been recorded from South America in Colombia (Young 1979). Forattini (1973) enlarges this subgenus by including L. saulensis, L. samueli, L. deleoni and L. vesicifera, species that are included in other species groups in the present review. León (1971) used the name Anthophorus, instead of Dampfomyia, for the subgenus containing the species treated here.

Medical Importance. Unknown; females feed on small mammals and L. anthophora is a probable host of Rio Grande Virus (Young & Perkins 1984).

Key to the males of the subgenus Dampfomyia

1. Style with 5 strong spines and a small subterminal sets. .....
..... L. insolita (Pl. 18-5)
Style with 2-3 strong spines and 2 small setae, one subterminal & one basal. ..... 2

2. Paramere with short, strongly clubbed dorsal arm. .....
..... L. anthophora (Pl. 18-1)
Paramere with longer, more slender dorsal arm. ..... 3

3. Genital filament tips markedly enlarged & modified. Paramere lacking acute ventral projection. ..... L. permira (Pl. 18-6)
Genital filament tips simple. Paramere with acute ventral projection. ..... 4

4. Paramere tip acute and pointed downwards; dorsal arm with 10-16 long setae. ..... L. rosabali (Pl. 18-4)
Paramere tip broadly rounded; dorsal arm with 20 or more long setae. ..... 5

5. Paramere clubbed apically; dorsal arm with long setae inserted on most of structure. ..... L. dodgei (Pl. 18-2)
Paramere more slender, unclubbed; dorsal arm with long setae restricted to distal half of structure. ..... L. atulapai (Pl. 18-3)

Key to the females of the subgenus Dampfomyia

1. Individual sperm ducts seemingly absent or shorter than spermathecal body. ..... 2

   Individual sperm ducts at least as long as spermathecal body. ..... 3

2. Spermathecae almost lacking individual ducts; the evaginations rounded & larger at sides than those finger-like projections near terminal knob. ..... L. permira (Pl. 18-6)

   Spermathecae with short but distinct individual ducts; all bubble-like evaginations subequal in size. ..... L. atulapai (Pl. 18-3)

   L. rosabali (Pl. 18-4)

3. Cibarium with four spine tipped horizontal teeth. .....

   ..... L. insolita (Pl. 18-5)

   Cibarium with two blade-like horizontal teeth. .....

   ..... L. anthophora (Pl. 18-1)

   L. dodgei (Pl. 18-2)

Lutzomyia (Dampfomyia) anthophora (Addis)

Plate 18-1

Phlebotomus anthophorus Addis 1945a: 119 (♂, ♀, Uvalde, Uvalde Co., Texas, U.S.A.).

Lutzomyia anthophora: Theodor 1965: 193 (♂, ♀ figs.). Young & Perkins 1984: 272 (full refs., figs., dist.). Magnarelli et al. 1984: 681 (age

grading ♀♀). Endris et al. 1984: 656 (laboratory biology); 1987a: 243 (as exper. vector of Leishmania mexicana); 1987b: 412 (egg surface morphol.).

Distribution (Map 18-1). Mexico & U.S.A. (Young & Perkins 1984).

Remarks. Lutzomyia anthophora has been successfully colonized in the laboratory by Addis (1945b) and Endris et al. (1984). The species is closely associated with Neotoma woodrats in southern Texas, U.S.A. (Young & Perkins 1984). A Phlebovirus, Rio Grande virus, was isolated from naturally infected woodrats near Brownsville, Texas and later (Endris et al. 1983) was transovarially transmitted by experimentally infected females of L. anthophora. In addition, this sand fly is a suitable laboratory vector of Leishmania mexicana (Endris et al. 1987a). Addis (1945b) described the immature stages.

## Lutzomyia (Dampfomyia) dodgei (Vargas & Nájera)

Plate 18-2

Phlebotomus dodgei Vargas & Nájera 1953a: 44 (♂, ♀, Cocula, Guerrero, Mexico); 1953b: 311 (dist., Mexico).

Lutzomyia dodgei: Barretto 1962: 95 (listed). Theodor 1965: 193 (listed). Forattini 1973: 329 (figs., review). Martins et al. 1978: 58 (dist.).

Distribution (Map 18-2). Mexico & El Salvador (Martins et al. 1978).

Remarks. Forattini (1973) considers L. dodgei and L. rosabali to be conspecific but there are significant structural differences between these taxa (cf. Plates 18-2 & 18-4). We examined more than 100 dodgei males from Morelos State, Mexico kindly provided by M. Camino who captured them in flight traps with males of L. anthophora. We are unable to separate the females by structure or color.

## Lutzomyia (Dampfomyia) atulapai (León)

Plate 18-3

Phlebotomus atulapai León 1971: 187 (♂, ♀, Rio Atulapa, Chiquimuta, Guatemala).

Phlebotomus dodgei (not dodgei Vargas & Nájera): Fairchild & Hertig 1956: 308 (in part). Rosabal & Trejos 1964: 168 (El Salvador); 1965: 222 (♂ fig., tax.).

Distribution (Map 18-1). Mexico (Fairchild & Hertig 1956, in part); Guatemala (León 1971); El Salvador (Rosabal & Trejos 1964; 1965).

Remarks. As with others in the León collection (1971), the holotype and allotype of L. atulapai are not labelled as such, but Figs. 1 & 2 and photographs 1 & 2 in his 1971 paper were of the specimens we examined. Both were unduly flattened when slide mounted years ago. We remounted the abdomen of the female but were unable to see details of the spermathecae.

The atalupai male, with the apically enlarged arm of the paramere, differs readily from L. dodgei (Vargas & Nájera 1953) which has a uniformly slender arm bearing setae from base to apex. The setae on the dorsal arm of the paramere of atalupai are restricted to the apically enlarged section. We believe that the "dodgei" discussed and illustrated by Fairchild & Hertig (1956) and Rosabal & Trejos (1964) represents atalupai (León) instead of dodgei (Vargas & Néjera). There are no significant differences between the Mexican and other available specimens when allowances are made for obvious distortion due to improper slide mounting technique. Fairchild & Hertig (loc. cit.) illustrated the spermathecae of the Mexican female. We examined this specimen and the male discussed and illustrated by them.

Lutzomyia (Dampfomyia) rosabali (Fairchild & Hertig)

Plate 18-4

Phlebotomus rosabali Fairchild & Hertig 1956: 310 (♂, Puerto Armuelles, Chiriqui, Panama).

Lutzomyia rosabali: Martins et al. 1978: 58. Young 1979: 91 (full references). Murillo & Zeledon 1985: 39 (♂, ♀ figs, Costa Rica).

Distribution (Map 18-2). Costa Rica (Murillo & Zeledon 1985); Panama (Fairchild & Hertig 1956); Colombia (Young 1979).

Remarks. Murillo & Zeledon (1985) captured 62 ♂♂ and 222 ♀♀ of this species in a squirrel's nest (Sciurus sp.) in Costa Rica. This finding and the fact that L. anthophora, a closely related species, also is associated with rodent's nests, suggests that other Lutzomyia (Dampfomyia) species may share similar habits.

## Lutzomyia (Dampfomyia) insolita (Fairchild & Hertig)

Plate 18-5

Phlebotomus insolitus Fairchild & Hertig 1956: 310 (♂, Almirante, Bocas del Toro, Panama).

Phlebotomus rubidulus Fairchild & Hertig 1956: 312 (♀, Mojinga Swamp, Canal Zone, Panama). Hanson 1968: 69 (larva, pupa). Christensen & Rutledge 1973: 314 (as synonym of insolitus).

Lutzomyia isolita: Barretto 1962: 95. Theodor 1965: 193. Forattini 1973: 330 (figs., review). Martins et al. 1978: 58 (dist.). Murillo & Zeledon 1985: 39 (o figs., dist., Costa Rica).

Distribution (Map 18-1). Costa Rica (Murillo & Zeledon 1985); Panama (Fairchild & Hertig 1956).

Remarks. Hanson (1968) described and illustrated the fourth instar larva and pupa of this species.

Lutzomyia (Dampfomyia) permira (Fairchild & Hertig)

Plate 18-6

Phlebotomus permirus Fairchild & Hertig 1956: 312 (♀, Palenque, Chiapas, Mexico). Lewis & Garnham 1959: 83 (♂ descript., Belize).

Phlebotomus tikalensis León 1971: 190 (♂, Dos Lagunas, Peten, Guatemala. NEW SYNONYMY).

Lutzomyia permira: Barretto 1962: 95 (listed). Theodor 1965: 193 (listed). Williams 1970b: 333 (Belize). Forattini 1973: 332 (♂, ♀ figs.). Williams 1976b: 603 (Belize). Martins et al. 1978: 58 (dist.).

Distribution (Map 18-3). Mexico (Fairchild & Hertig 1956); Guatemala (León 1971); Belize (Martins et al. 1978).

Remarks. The L. tikalensis males, described and illustrated by León (1971) and examined by us through the courtesy of C.H. Porter, are morphologically indistinguishable from L. permira.

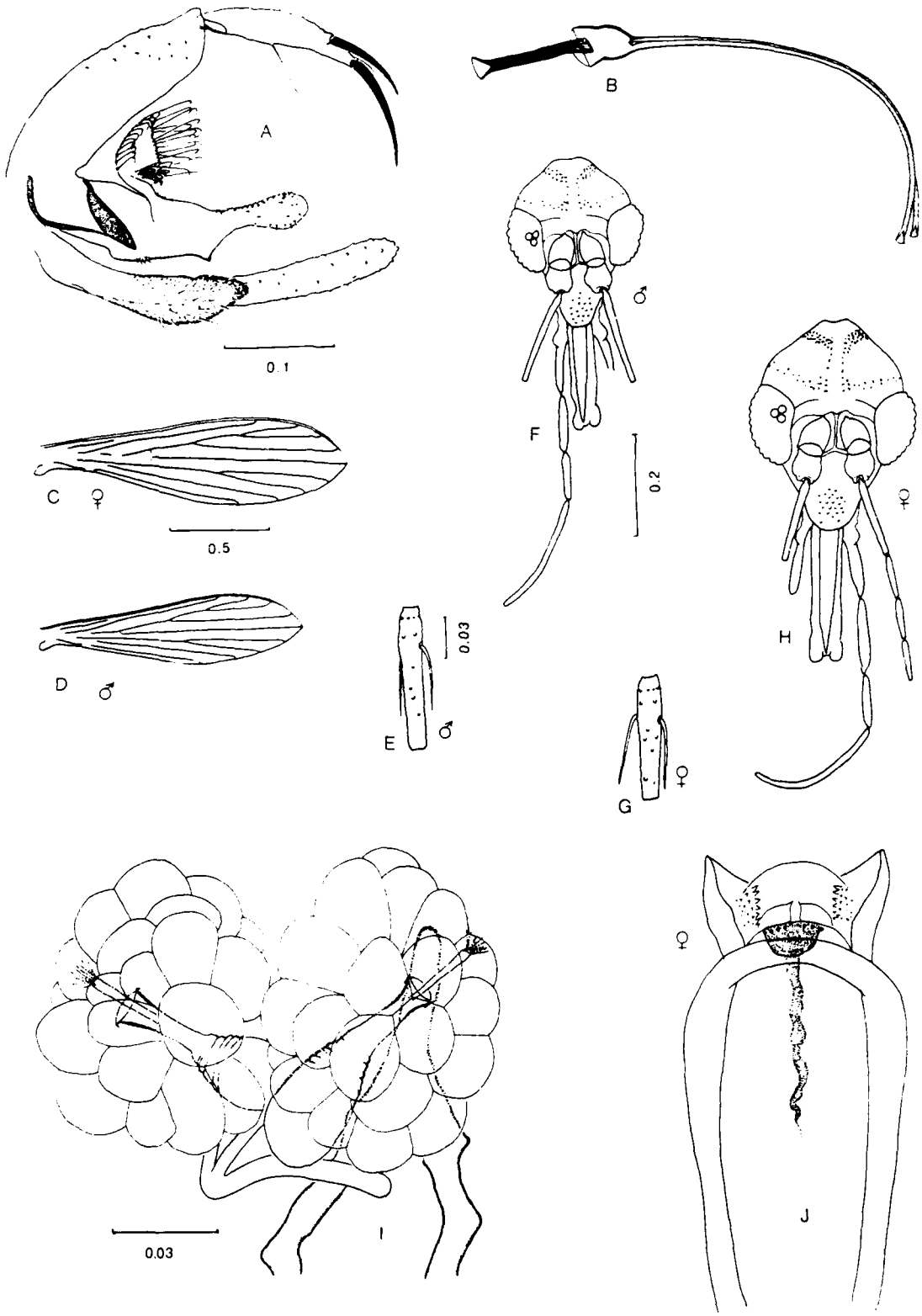



Plate 18-1

Lutzomyia anthophora. A. Male terminalia; B. Genital pump & filaments; C. Female wing; D. Male wing; E. Male flagellomere II; F. Male head; G. Female flagellomere II; H. Female head; I. Spermathecae; J. Female cibarium (from Young & Perkins 1984).

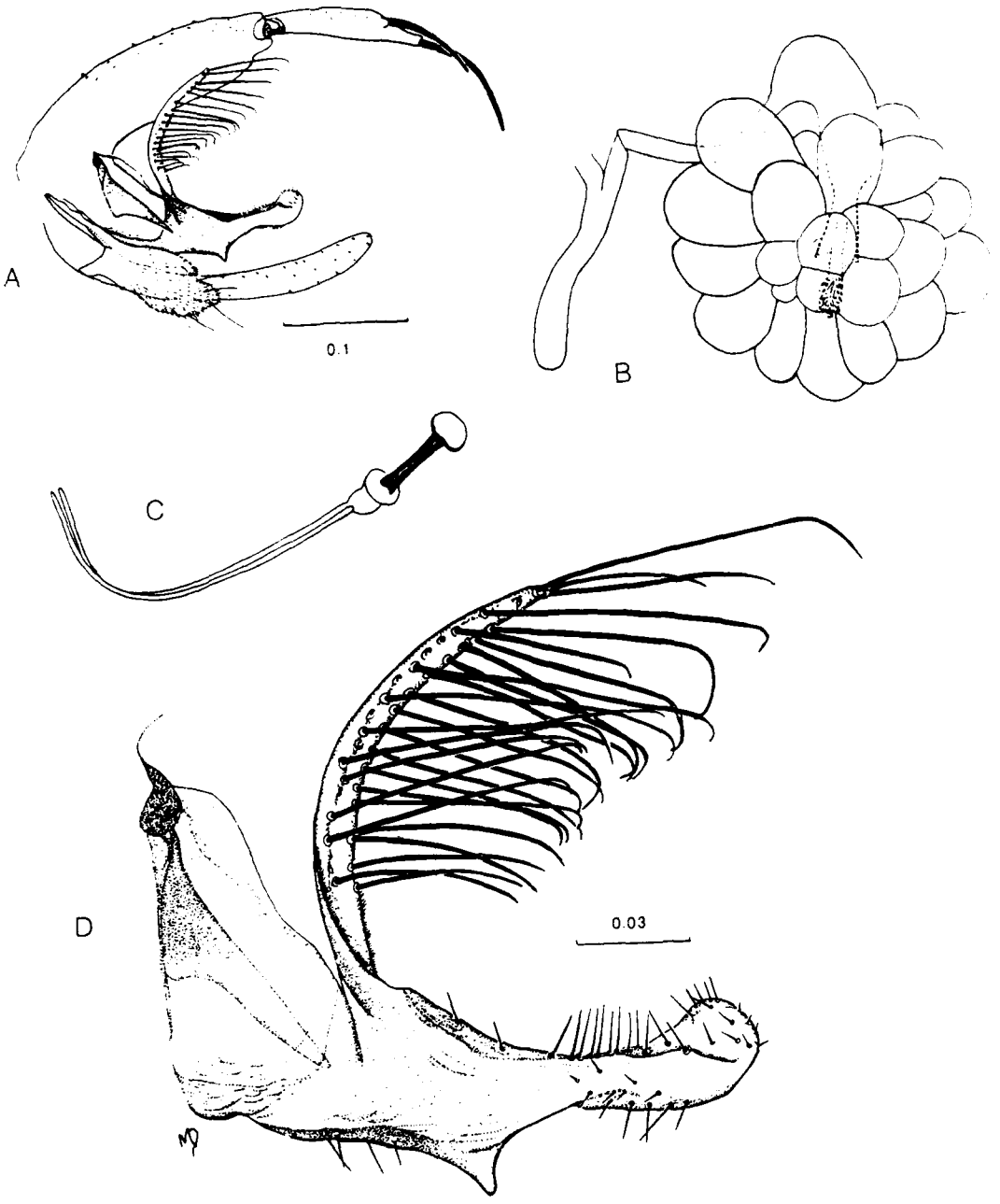



Plate 18-2

Lutzomyia dodgei. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Paramere.

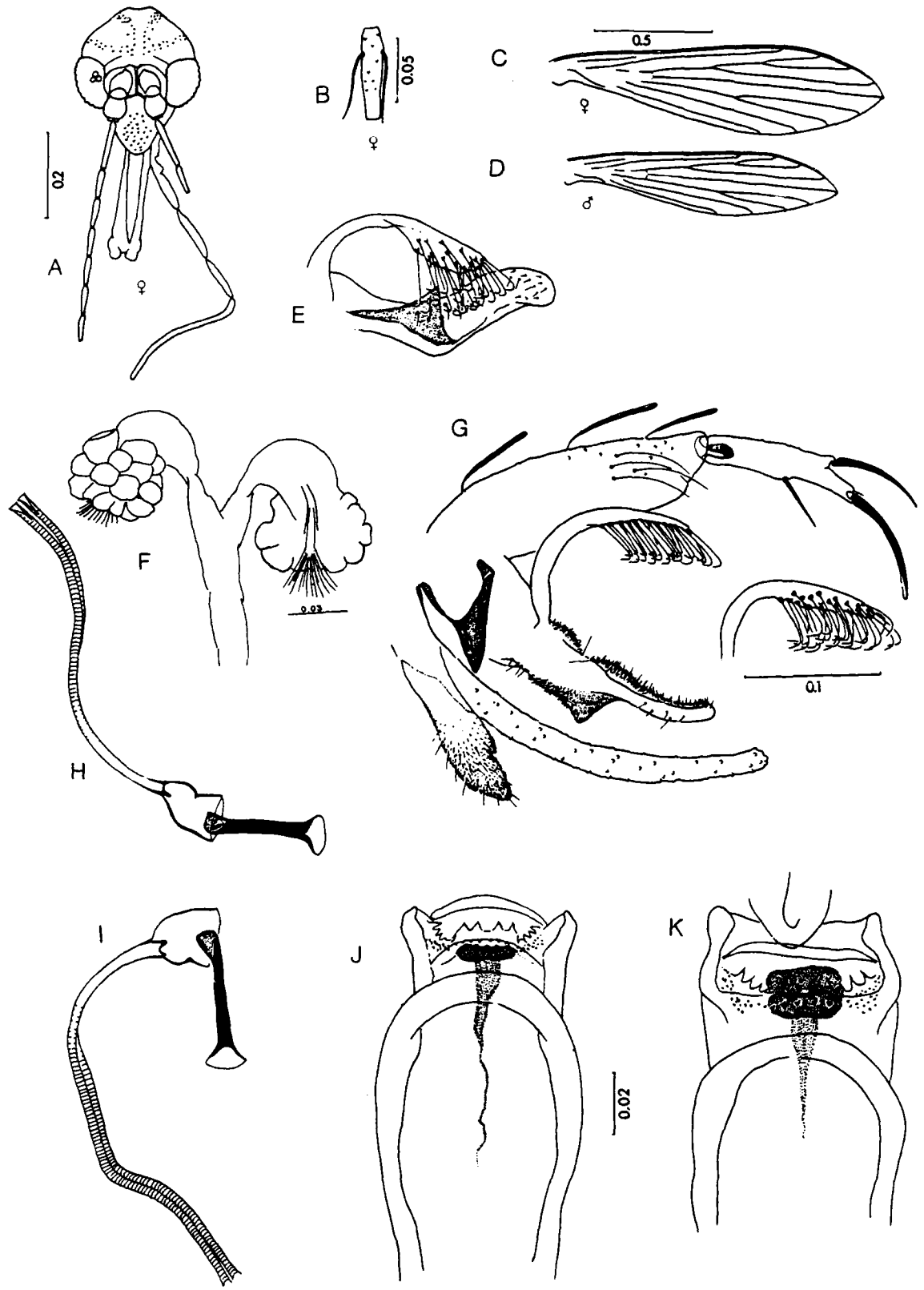



Plate 18-3

Lutzomyia atulapai. A. Female head; B. Female flagellomere II; C. Female wing; D. Male wing; E. Paramere & aedeagus, flattened; F. Spermathecae; G. Male terminalia; H & I. Genital pump & filaments; J. Female cibarium; K. Female cibarium, flattened (fig. F from Fairchild & Hertig 1956).

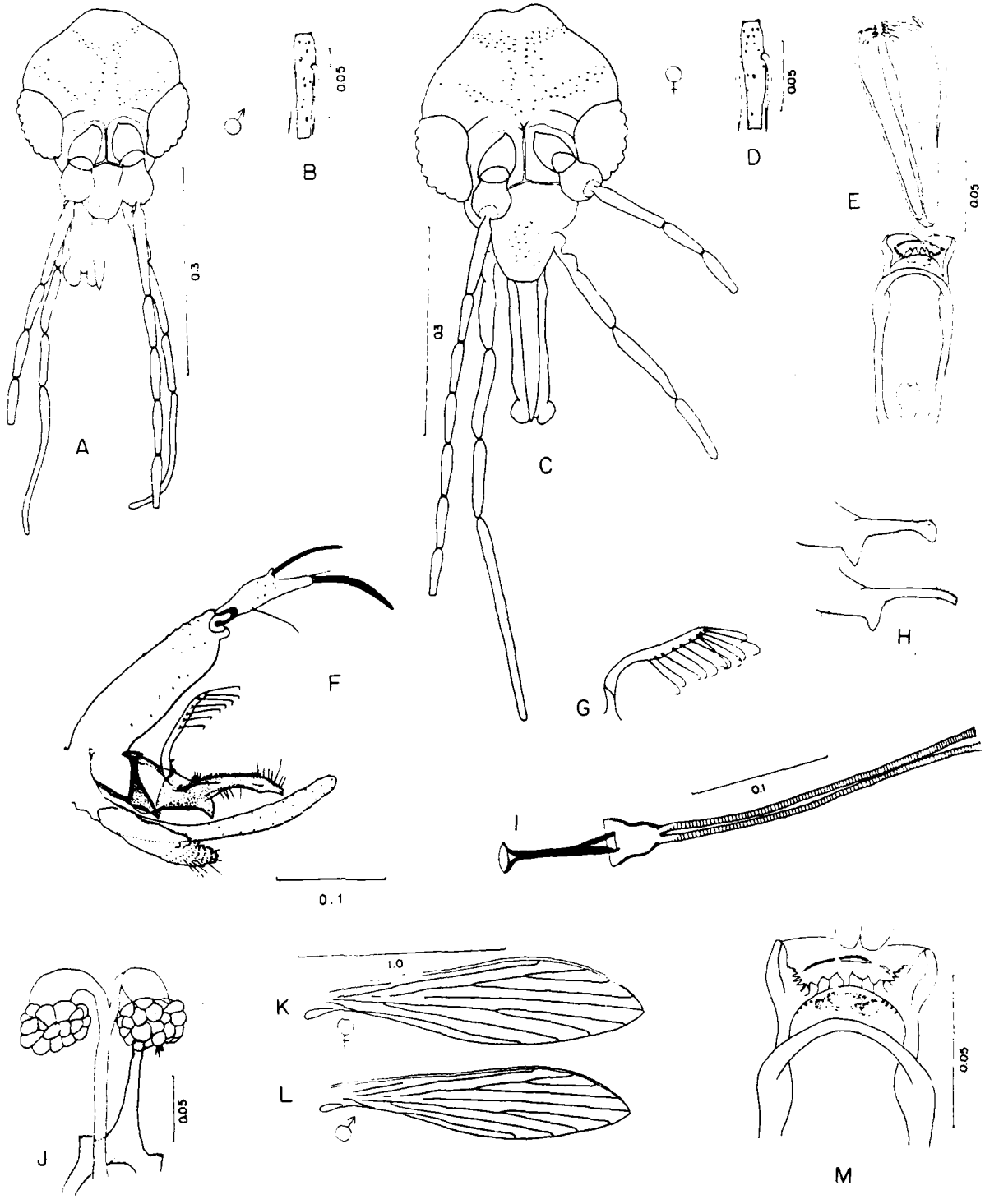



Plate 18-4

Lutzomyia rosabali. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Dorsal arm of paramere; H. Parameres; I. Genital pump & filaments; J. Spermathecae; K. Female wing; L. Male wing; M. Female cibarium (from Young 1979).

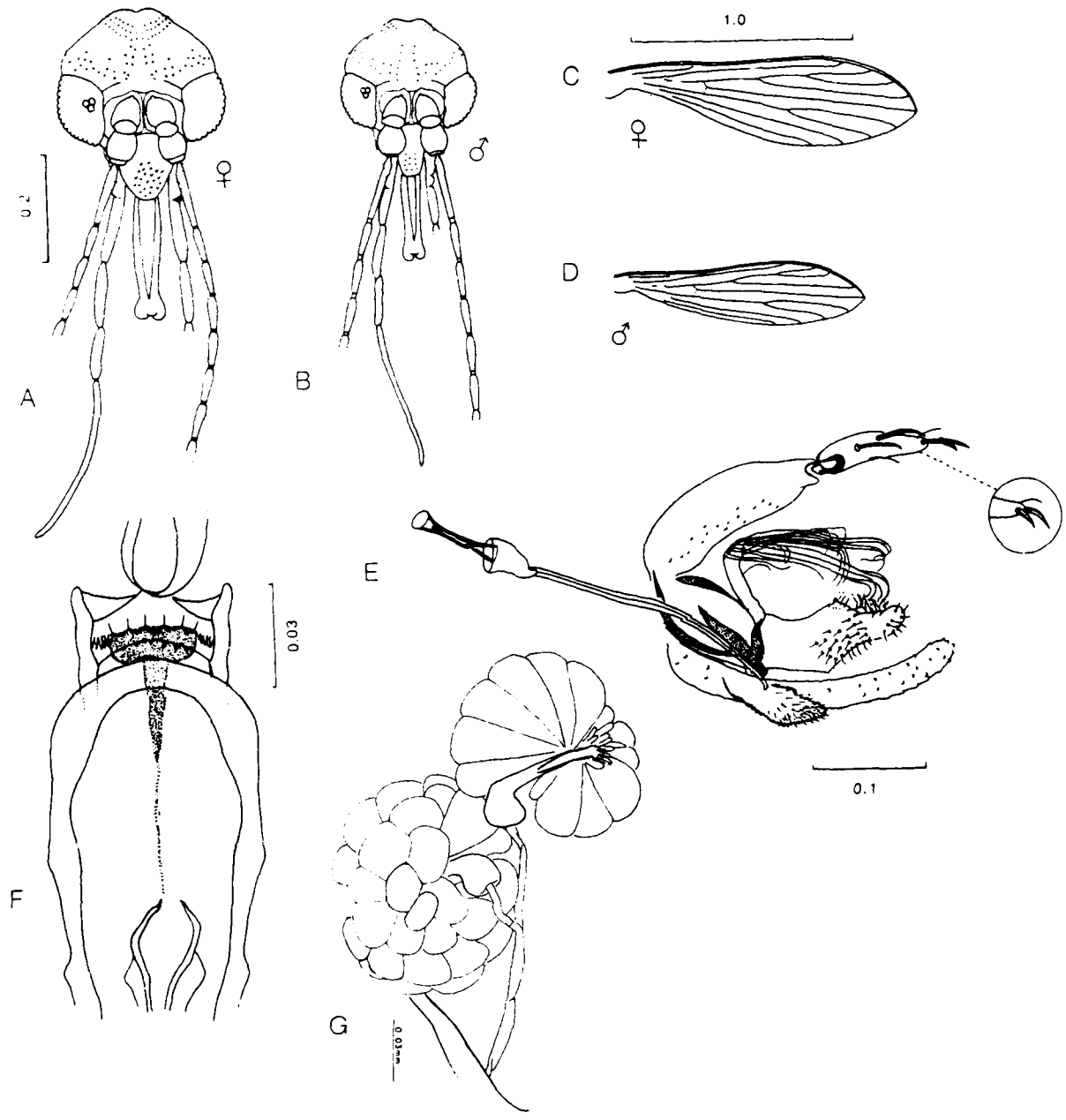



Plate 18-5

Lutzomyia isolita. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Male terminalia; F. Female cibarium; G. Spermathecae (fig. G. from Fairchild & Hertig 1956).

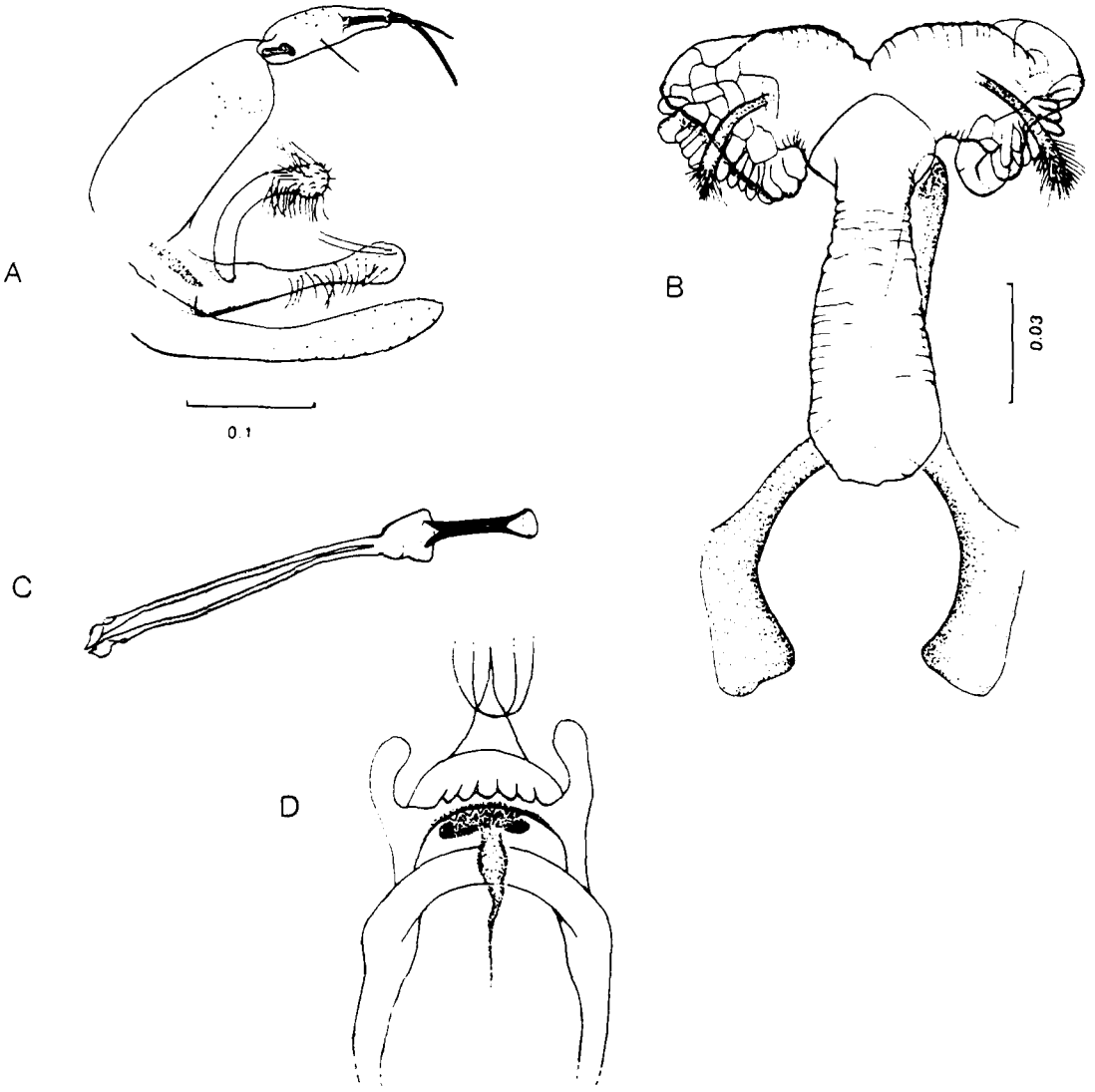



Plate 18-6

Lutzomyia permira. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Female cibarium.




MAP 18-1




MAP 18-2




MAP 18-3

## 19. Lytzomyia Species Group Saulensis

Lutzomyia species group saulensis: Lewis et al. 1977. Young 1979: 69.

Lutzomyia subgenus Dampfomyia: Forattini 1973: 327 (in part).

Lutzomyia subgenus Coromyia: Martins et al. 1978: 93 (in part).

Identification. Coloration pale. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with 4 pointed horizontal teeth & complete arch. Pharynx unarmed. Spermathecae with bubble-like evaginations, terminal part smooth-walled & tapered. ♂ genitalia. Coxite with 4-8 persistent setae at base. Style with 4 spines & subterminal seta. Paramere with 2 acute, ventral projections.

The two species in this group share character states with members of the verrucarum species group (= Coromyia Barretto, in part) and with the Dampfomyia species. The spermathecae, however, differ from those of the Dampfomyia species (Theodor 1965) and the males have persistent setae on their coxites. At present, we provisionally separate L. saulensis and L. wilsoni from these other groups.

The females of these two species are structurally similar and associated males must be on hand before definitive identifications can be made.

Medical Importance. Unknown; females have been rarely captured on human bait.

Key to the males of the species group Saulensis

1. Paramere with large dorsal hump bearing numerous long setae. ..... L. wilsoni (Pl. 19-1)

   Paramere without dorsal hump. ..... L. saulensis (Pl. 19-2)

Lutzomyia wilsoni (Damasceno & Causey)

Plate 19-1

Flebotomus wilsoni Damasceno & Causey 1945: 639 (♂, Itauña, Parintins, Amazonas, Brazil).

Lutzomyia wilsoni: Forattini 1973: 357 (♂). Martins et al. 1978: 94 (dist.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Martins et al. 1983a: 67 (♀ descript., dist.). Arias et al. 1985: 1101 (negative for flagellates, Brazil).

Distribution (Map 19-1). Brazil (Martins et al. 1978; 1983a; Biancardi et al. 1982).

Remarks. From associated females collected at Costa Marquez, Rondonia, Brazil (T. Klein), we observed that the tapered ends of the L. wilsoni spermathecae are stouter than those of L. saulensis from Panama (cf. Plates 19-1 & 19-2). This may or may not be a reliable diagnostic character; more material is needed to confirm this possibility.

Lutzomyia saulensis (Floch & Abonnenc)

Plate 19-2

Phlebotomus saulensis Floch & Abonnenc 1944a: 1 (♂, Saul, Haute Mana, French Guiana).

Phlebotomus pinealis Floch & Abonnenc 1944b: 11 (♀, Crique Anguille, French Guiana). Fairchild & Hertig 1958b: 204 (refs., as synonym of saulensis). Hanson 1968: 69 (1st larval instar).

Lutzomyia saulensis: Theodor 1965: 196 (♂, ♀ figs.). Forattini 1973: 333 (o, ♀ figs., dist.). Llanos 1973: 34 (figs., Peru). Llanos et al. 1975b: 671 (Peru). Leger et al. 1977: 227 (French Guiana). Martins et al. 1978: 94 (figs., refs., dist.). Young 1979: 69 (refs., figs.). Llanos 1981: 183 (Peru). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Martins et al. 1983a: 67 (cf. to ♀ wilsoni). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Murillo & Zeledon 1985: 67 (♂, ♀ figs., dist., Costa Rica). Ryan 1986: 87 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil). Lebbe et al. 1978: 30 (computer aided ident.).

Distribution (Map 19-2). Costa Rica (Murillo & Zeledon 1985); Panama (Martins et al. 1978); Colombia (Young 1979); Peru (Llanos 1981); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); French Guiana (Leger et al. 1977; Martins et al. 1978).

Remarks. The first instar larva was described by Hanson (1968). Later instars did not feed and could not be reared beyond the first stage.

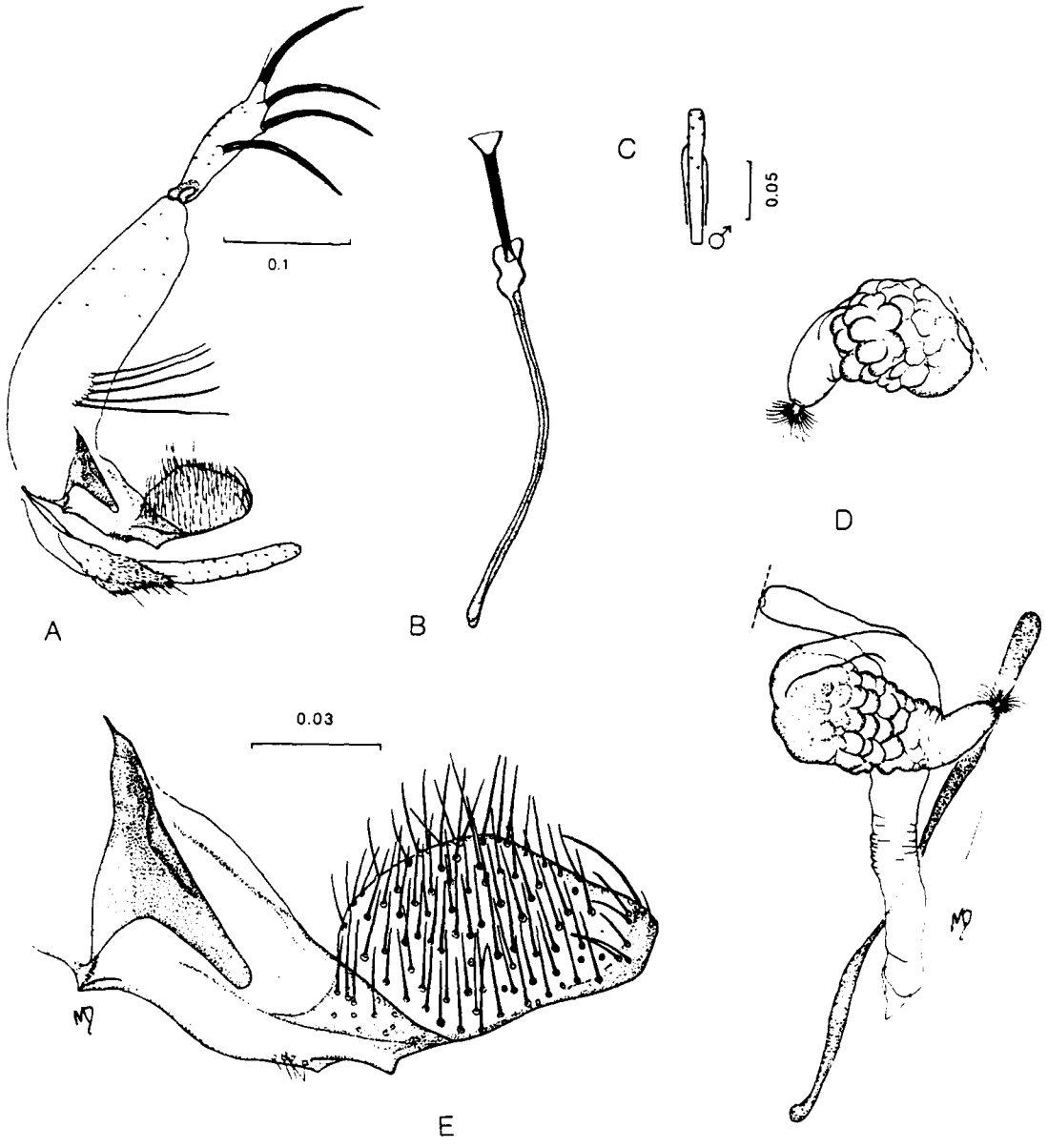



Plate 19-1

Lutzomyia wilsoni. A. Male terminalia; B. Genital pump & filaments; C. Male flagellomere II; D. Spermathecae; E. Paramere; F. Spermatheca.

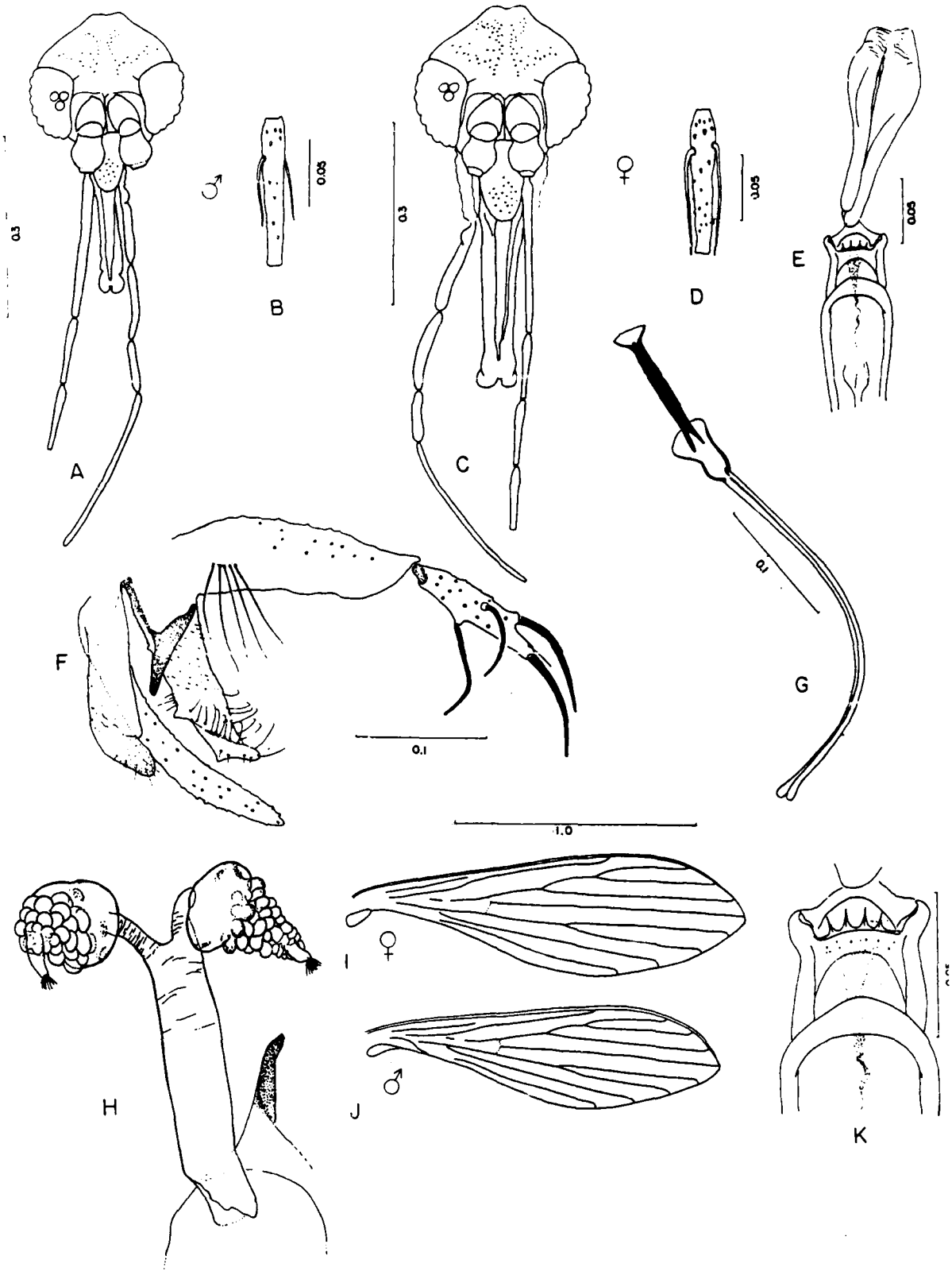



Plate 19-2

Lutzomyia saulensis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).




MAP 19-1

wilsoni ✱




MAP 19-2

saulensis ●

## 20. Lutzomyia Subgenus Pintomyia

Phlebotomus subgenus Pintomyia Costa Lima 1932: 44 (type species: Phlebotomus fischeri Pinto by orig. designation).

Phlebotomus group triacanthus Fairchild 1955: 194 (series fischeri).

Lutzomyia subgenus Pintomyia: Barretto 1962: 92. Theodor 1965: 192. Lewis et al. 1977: 325. Martins et al. 1978: 25.

Lutzomyia genus Pintomyia: Forattini 1971a: 103; 1973: 497.

Identification. Coloration dark. Head broad. Antennal ascoids simple. Palpomere 5 larger than palps. 3 + 4. ♀ cibarium with 4 horizontal teeth, sometimes very short in an irregular row; 2-3 rows of vertical teeth; arch complete; pigment patch conspicuous or not. Pharynx unarmed. Spermathecae suboval without terminal knob, ductules (= "hairs") present; individual sperm ducts well sclerotized, in part; common duct long, nonsclerotized. ♂ genitalia. Coxite with basal group of persistent setae. Style with 4 large spines; subterminal seta present. Paramere simple. Hind femur of both sexes with a row of 3-8 spines.

This is a distinctive subgenus of Lutzomyia containing 5 or 6 species. Aguiar & Soucasaux (1984) reported, but did not describe, a Pintomyia sp. from Serra dos Orgao, Rio de Janeiro, Brazil. We have not seen material from there.

Medical Importance. Two species are anthropophilic and one of them, L. pessoai, has been found naturally infected with promastigotes believed to be Leishmania.

Key to the Males of the Subgenus Pintomyia*

1. Palpomere 5 longer than flagellomere I. ..... 2
   Palpomere 5 shorter than flagellomere I. ..... 3

2. Style with proximal spines inserted almost on same level. Coxite with basal tuft of 10 or more setae. Paramere with 1-2 isolated dorsal setae near middle of structure. ..... L. pessoai (Pl. 20-1)
   Style with proximal spines well separated as shown. Coxite with basal tuft of 2-5 setae. Paramere without isolated dorsal setae. ..... L. fischeri (Pl. 20-2)

3. Paramere relatively slender with dorsal setae implanted over distal half of structure. ..... Lutzomyia (Pintomyia) n.sp. #1 (Pl. 20-3)
   Paramere broader with dorsal setae restricted to distal third of structure. ..... L. damascenoi (Pl. 20-4)

*The male of L. gibsoni is unknown.

## Key to Females of the Subgenus Pintomyia

1. Labrum ( > 0.30 mm) or palpomere 5 as long as, or longer than, flagellomere I. Cibarium with 4 prominent horizontal teeth differing markedly from vertical teeth; pigment patch conspicuous, with dark transverse band near horizontal teeth. ..... 2

   Labrum ( < 0.30 mm) or palpomere 5 shorter than flagellomere I. Cibarium with 4 inconspicuous horizontal teeth but slightly larger than largest vertical teeth; pigment patch poorly defined, without dark transverse band at posterior end, i.e., near horizontal teeth. ..... L. damascenoi (Pl. 20-4)

   Lutzomyia (Pintomyia) n.sp. #1 (Pl. 20-3)

2. Spermathecae subcylindrical. ..... L. fischeri (Pl. 20-2)

   ? L. gibsoni

   Spermathecae subpherical. ..... L. pessoai (Pl. 20-1)

### Lutzomyia (Pintomyia) pessoai (Coutinho & Barretto)

Plate 20-1

Phlebotomus pessoai Coutinho & Barretto 1940a: 98 (♂, ♀, Pompeia, Sao Paulo, Brazil).

Flebotomus pessoai: Barretto 1947a: 281 (full refs.).

Lutzomyia pessoai: Barretto 1962: 93 (listed). Theodor 1965: 192 (listed). Martins et al. 1978: 28 (refs., dist.) Aguiar & Soucasaux 1984: 199

(seasonal biting habits, Brazil). Aguiar et al. 1985a: 188 (vertical dist.); 1985b: 340 (coll. data); 1985c: 467 (coll. data). Vexenat et al. 1986: 296 (Bahia, Brazil).

Pintomyia pessoai: Forattini 1971a: 104 (listed); 1973: 498 (figs., tax.).

Distribution (Map 20-1). Brazil; Argentina; Paraguay (Martins et al. 1978). Also, 7 ♂♂, Sommerfeld, Yhú, Paraguay, 24 March 1950, M. Hertig).

Remarks. Promastigotes, believed to be Leishmania braziliensis, were observed in 8 out of 2711 L. pessoai females individually dissected in the early 1940's by Pessoa and colleagues (see Johnson et al. 1963). Later, while also working in Sao Paulo State, Brazil, Forattini et al. (1972) observed Leishmania in the nose of a hamster that had been inoculated with a triturated group of 179 L. pessoai. In view of these results and of the man-biting behavior of L. pessoai, this sand fly is regarded as a suspected vector of Leishmania braziliensis in southern Brazil. Further efforts are needed to identify the parasites using modern methods.

Forattini (1973) reviewed the habits of L. pessoai in southern Brazil.

Lutzomyia (Pintomyia) fischeri (Pinto)

Plate 20-2

Phlebotomus fischeri Pinto 1926: 373 (♂, Butantan, São Paulo, Brazil).

Theodor 1932: 22 (♀).

Flebotomus fischeri: Barretto 1947a: 199 (full refs.).

Lutzomyia fisheri: Barretto 1962: 93 (listed). Theodor 1965: 192 (♂, ♀ figs.). Llanos 1973: 33 (♀, Peru). Martins et al. 1978: 27 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Llanos 1981: 183 (Peru). Aguair & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Barros et al. 1985: 150 (Espirito Santo, Brazil). Aguair et al. 1985a: 188 (vertical dist.); 1985b: 340; 1985c: 467; 1986: 478 (coll. data, habits, Brazil). Vexant et al. 1986: 296 (Bahia, Brazil). Aguiar & Vilela 1987: 585 (tree trunk resting sites).

Pintomyia fischeri: Forattini 1971a: 104 (listed); 1973: 500 (figs., tax.). Gomes et al. 1986: 282 (ecology, São Paulo, Brazil).

Distribution (Map 20-2). Brazil; Peru (Martins et al. 1978); Paraguay (1 ♂, 4 ♀♀, Acá-Pai, San Pedro, May 1950, M. Hertig; 2 ♂♂, 1 ♀, Sommerfeld, Yhú, March 1950, M. Hertig).

Remarks. Lutzomyia fischeri, an anthropophilic species, has not been reported previously in Paraguay. Favored resting sites appear to be tree trunks; females are frequently found inside and near houses where they attack man. Trypanosomes have been isolated from wild-caught females in Bahia, Brazil (Ryan et al. 1987c).

The immature stages were first described by Barretto (1941).

### Lutzomyia (Pintomyia) gibsoni (Pifano & Ortiz)

Phlebotomus gibsoni Pifano & Ortiz 1972: 29 (♀, Sierra Parima, Amazonas, Venezuela).

Lutzomyia gibsoni: Martins et al. 1978: 27 (as junior synonym of fischeri). Young 1979: 95 (mention).

Distribution (Map 20-2). Venezuela (type locality).

Remarks. The status of L. gibsoni remains undetermined. It was described from a single female, incorrectly designated the allotype, and is now apparently lost (D. Feliciangeli, pers. comm.). Martins et al (1978) treat L. gibsoni as a junior synonym of L. fischeri, without explanation, but the widely separated geographic ranges of these taxa suggest that they are not conspecific.

It will be necessary to collect and study males from the type locality before this species can be recognized with certainty.

Lutzomyia (Pintomyia) n. sp. #1

Plate 20-3

Phlebotomus spinosus (not spinosus Floch & Abonnenc): Hertig & Fairchild 1950: 92 (abdominal sternites, figs.). Johnson & Hertig 1961: 765 (rearing data). Hanson 1968: 80 (figs., larva, pupa).

Lutzomyia spinosa (not spinosus Floch & Abonnenc): Christensen & Fairchild 1971: 302 (Panama). Christensen 1972a: 88 (listed). Christensen 1972: 88 (listed). Osorno et al. 1972a: 60 (in part, Colombia). Christensen & Herrer 1973: 579 (coll. data, Panama). Martins et al. 1978: 29 (in part, dist.). Young 1979: 93 (in part, ♂, ♀ figs., refs.). Christensen et al. 1983: 466 (Panama). Ryan 1986: 81 (♂, ♀ figs., dist. Pará, Brazil).

Pintomyia spinosa (in part): Forattini 1973: 505 (tax.).

Distribution (Map 20-3). Panama (Christensen & Fairchild 1971; Young 1979); Colombia; Brazil (Young 1979, in part; 1 ♂, Veracruz, Maranhao 1962, J. Silva; Ryan 1986); Trinidad (1 ♂, Turure Forest, 1968, E. Tikasingh; 1 ♀, Arena Forest, 1955, T. Aitken).

Remarks. Sand flies in the subgenus Pintomyia, previously identified as L. spinosa (Floch & Abonnenc) in Panama, Colombia (in part) and Brazil (Christensen & Fairchild 1971; Young 1979) differ from the spinosa holotype in details of the male terminalia and, therefore, will be given a new name in a forthcoming paper.

This species, illustrated by Young (1979) and Ryan (1986) as L "spinosa," has also been taken in Trinidad. Records, other than those from Brazil given by Young (1979) and Ryan (1986) may or may not represent this new species. These include those of Martins et al. (1978), Biancardi et al. (1982) and Arias et al. (1985). However, one male from Varacruz, Maranhao, Brazil, determined as L. spinosa by A.V. Martins, is conspecific with Lutzomyia (Pintomyia) n.sp. #1.

All males examined by us from French Guiana are referable to L. damascenoi (= spinosus Floch & Abonnenc).

Nearly all of our specimens of this new species were taken on tree trunks; a few were captured in light traps. Hanson (1968) described the larva and pupa from Panama material.

Lutzomyia (Pintomyia) damascenoi (Mangabeira)

Plate 20-4

Flebotomus damascenoi Mangabeira 1941e: 369 (♂, ♀, Aura, Belém, Pará, Brazil). Barretto 1947: 196 (refs.). Damasceno et al. 1949: 823 (dist., Pará, Brazil). Barretto 1951: 224 (dist.).

Phlebotomus damascenoi: Floch & Abonnenc 1952: 31,42 (keyed).

Phlebotomus spinosus Floch & Abonnenc 1942b: 1 (♂, Gallion, French Guiana); 1945c: 2 (♀ keyed); 1952: 80 (♂, ♀ figs., redescript., French Guiana). (NEW SYNONYM).

Lutzomyia damascenoi: Barretto 1962: 93 (listed). Theodor 1965: 183 (listed). Lewis 1975a: 501 (mouthpart morphol.). Martins et al. 1978: 27 (refs., dist.). Lainson et al. 1979: 240 (biting man, Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil).

Lutzomyia spinosa: Barretto 1962: 93 (listed). Theodor 1965: 183 (listed). Leger et al. 1977: 227 (French Guiana). Martins et al. 1978: 29 (in part, dist.). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 35 (as potential vector of Leishmania).

Distribution (Map 20-4). Colombia (Martins et al. 1978; ♂ , La Macarena, 1987, C. Ferro); French Guiana (Leger et al. 1977; Martins et al. 1978; Geoffroy et al. 1986); Brazil (Martins et al. 1978; Ryan 1986).

Remarks. We examined the L. spinosa holotype through the kindness of F. Rodhain, Institute Pasteur, Paris, in 1987 and concluded that it and 12 other Pintomyia males from French Guiana were conspecific. We also compared these specimens and females from there with topotypes of L. damascenoi from Belém, Brazil. The shape and setation of the parameres of these males are indistinguishable with the dorsal setae restricted to the apical third of the structure. The number of setae of the coxite tuft ranged from 8 to 10 for 9 males from French Guiana and 12-14 for two males from Belém. No other structural differences among these males or females were noted. Forattini (1973) suggested that L. damascenoi and L. spinosa might be goegraphic variants of a single species but separated the females by differences in their individual sperm ducts,

i.e., those of L. damascenoi are heavily sclerotized throughout, unlike L. spinosa which has only part of each duct markedly sclerotized. Females from Belém and French Guiana were identical in this and other character states.

Thus, in our view, the presence of slightly more coxite setae of the males from Belém, does not warrant the separation of these forms as distinct species.

Distribution records of L. damascenoi and L. spinosa are complicated because of the existence of Lutzomyia (Pintomyia) n.sp. #1 that occurs in Colombia and Brazil where L. damascenoi also occurs. We have not seen Brazilian specimens reported by Martins et al. (1978) or Arias & Freitas (1977, 1978) and therefore do not know if they refer to L. damascenoi (as spinosa) or to Lutzomyia (Pintomyia) n.sp. #1, in part of whole. Similarly, it is not clear if the sand fly that was parasitized by a mite in Colombia represented L. damascenoi (as spinosa) or the new species (Lewis & Macfarlane 1981).

Specimens from north Pará State, Brazil, and identified as L. spinosa (Floch & Abonnenc) Ready et al. (1986) are referable to L. damascenoi (= spinosa) and not Lutzomyia (Pintomyia) n.sp. #1. We have also examined several males and females that are conspecific with L. damascenoi from Manaus, Amazonas, Brazil.

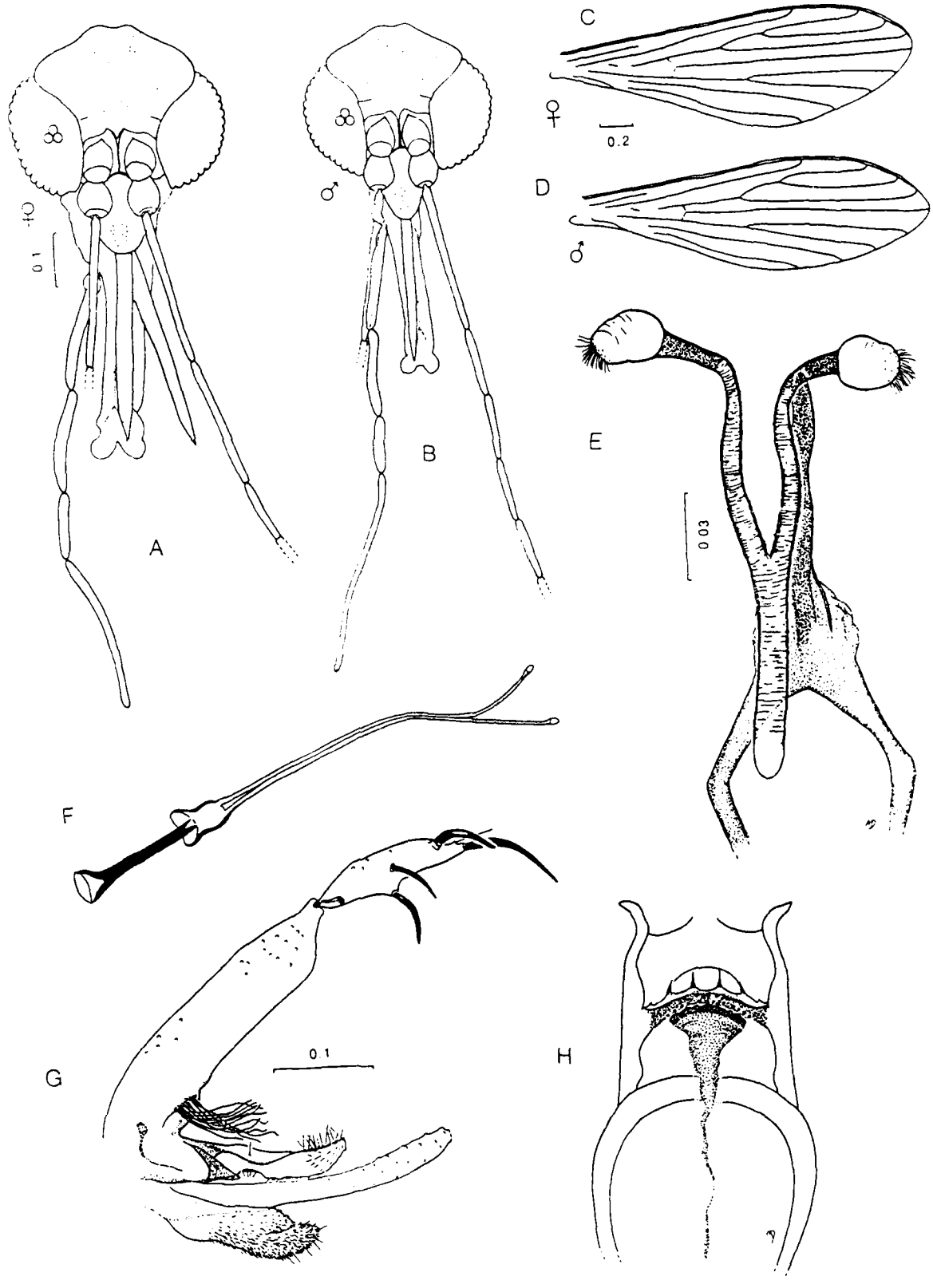



Plate 20-1

Lutzomyia pessoai. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Spermathecae; F. Genital pump & filaments; G. Male terminalia; H. Female cibarium.

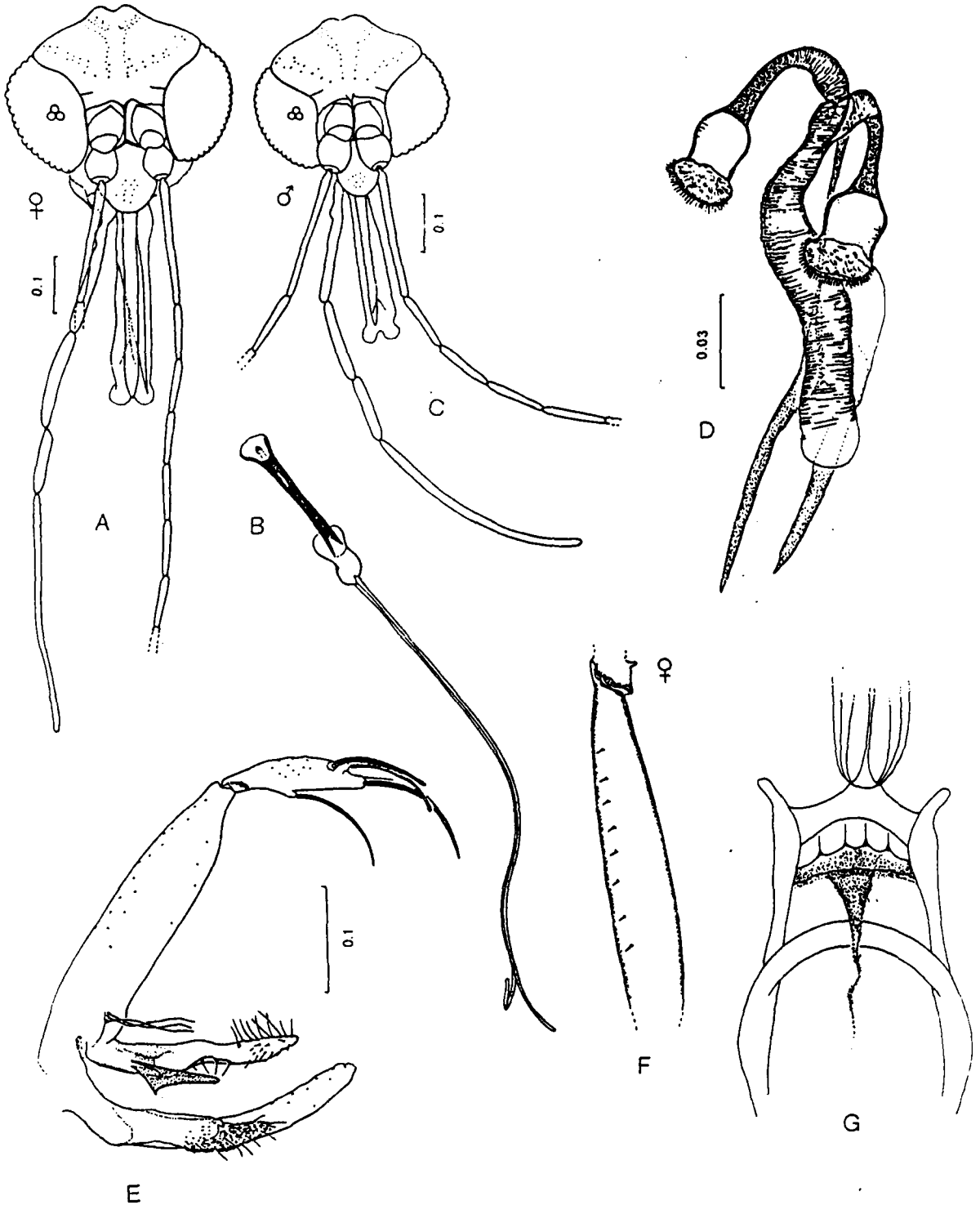



Plate 20-2

Lutzomyia fischeri. A. Female head, B. Genital pump & filaments, C. Male head, D. Spermathecae, E. Male terminalia, F. Female femur of hind leg showing row of spines, G. Female cibarium.

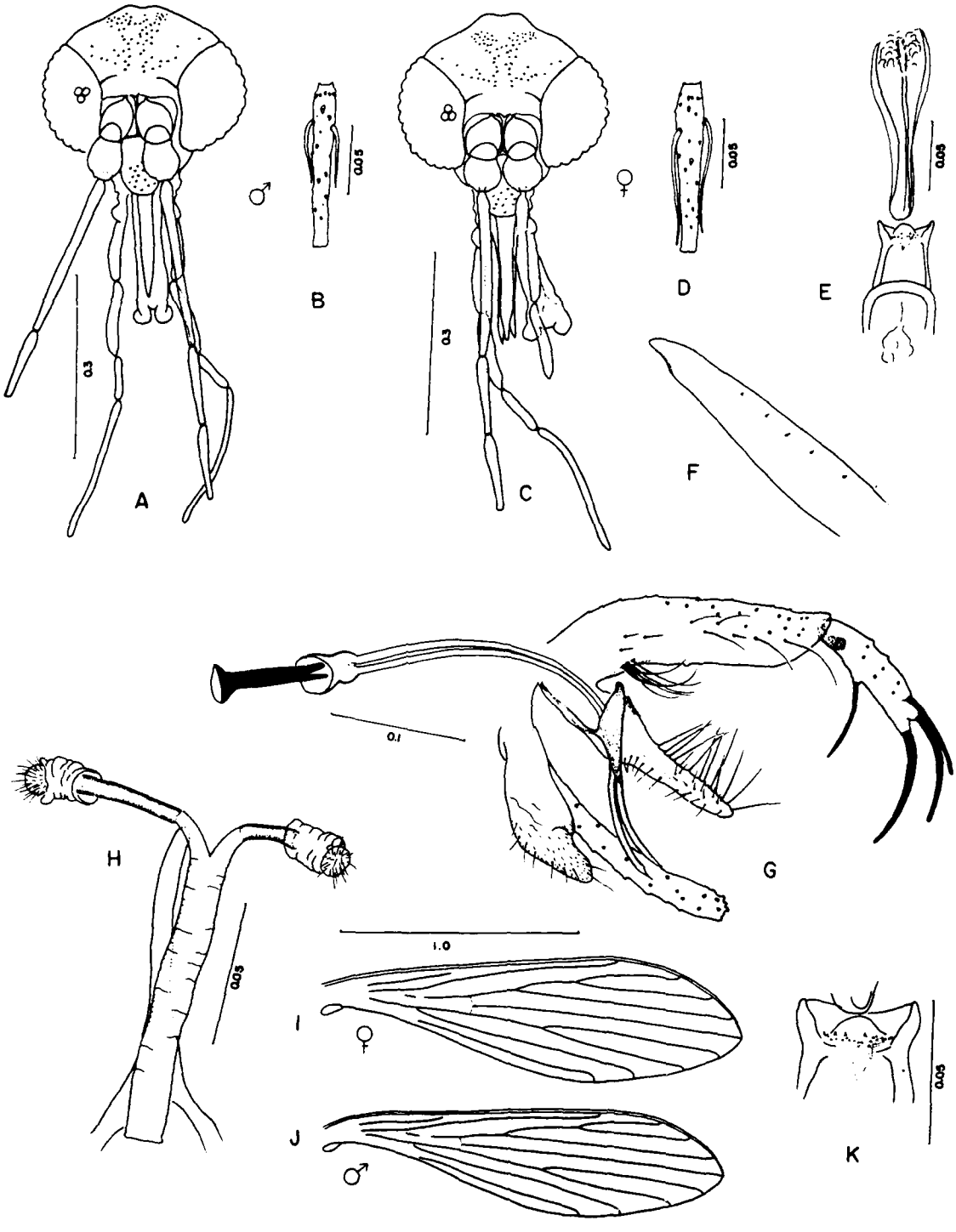



Plate 20-3

Lutzomyia (Pintomyia) n.sp. #1. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Hind femur showing row of spines; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979)

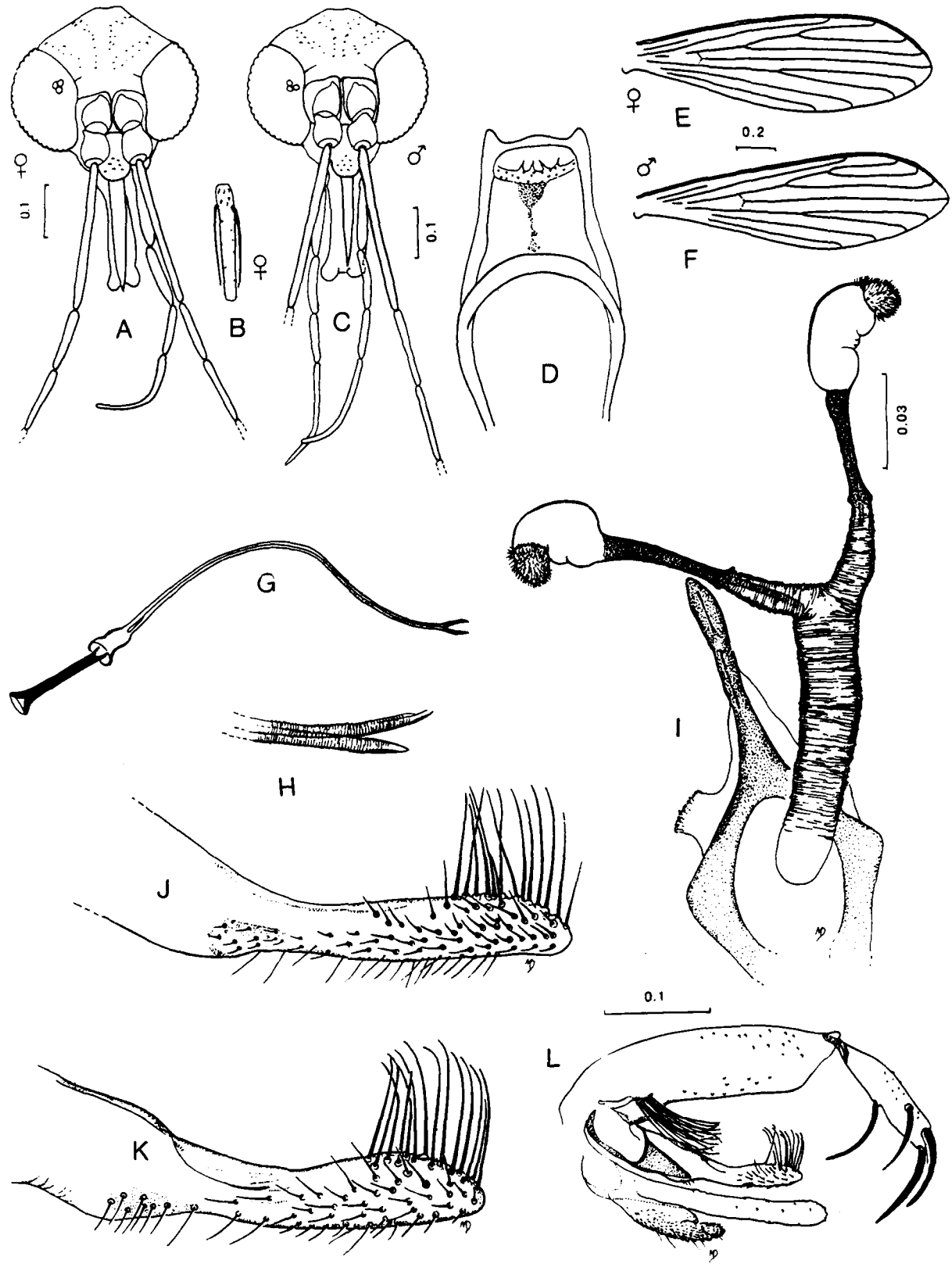


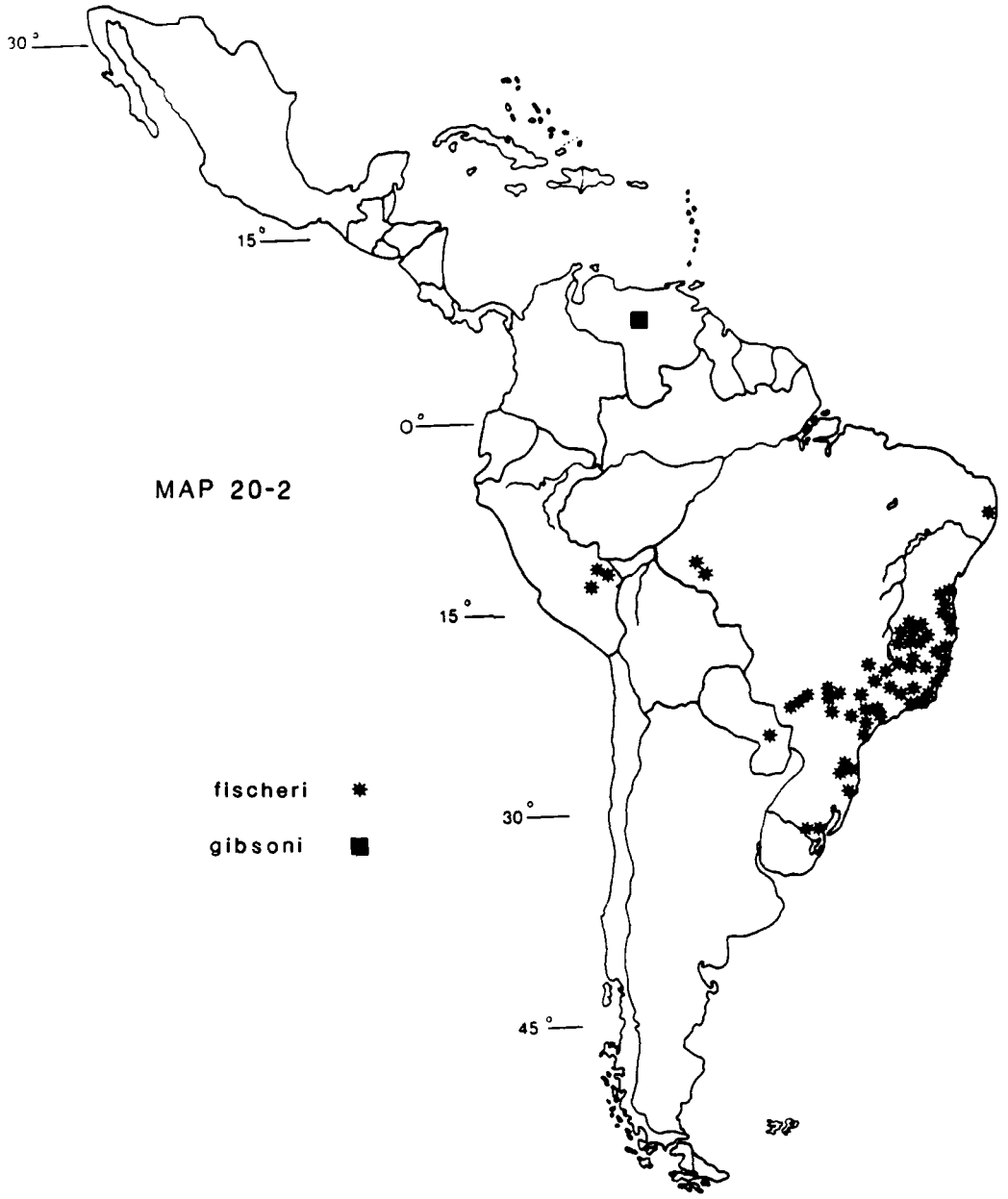

Plate 20-4

Lutzomyia damascenoi. A. Female head; B. Female flagellomere II; C. Male head; D. Female cibarium; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Tips of genital filaments; I. Spermathecae; J. Paramere; K. Paramere; L. Male terminalia.




MAP 20-1

pessoai ✡




MAP 20-2




MAP 20-3

L.(Pintomyia) n.sp. #1 • ?


30°
15°
0°
15°
30°
45°
MAP 20-4
damascenoi

## 21. Lutzomyia Subgenus Pressatia Mangabeira

Lutzomyia subgenus Pressatia Mangabeira 1942c: 131 (type species: Flebotomus triacanthus Mangabeira by orig. designation). Barretto 1962: 94. Theodor 1965: 112. Martins et al. 1978: 52 (defined).

Lutzomyia genus Pressatia: Forattini 1971a: 106; 1973: 511.

Identification. Coloration dusky to dark. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with 4 horizontal teeth & distinct group of vertical teeth on each side of cibarium; arch complete & pigment patch distinct. Pharynx unarmed. Spermathecal smooth-walled capsules with protruding terminal knob; individual ducts sclerotized, much shorter and thinner than common duct. ♂ genitalia. Coxite with 1-3 groups of persistent setae. Style with 2-3 large spines inserted at different levels plus a subterminal seta & small median-distal seta. Paramere usually ending in a short finger-like lobe, acute ventral projection present. Lateral lobe arched upwards, relatively long without modified dorsal setae. Genital filaments with transverse striations distally.

Medical Importance. Unknown; females are not commonly attracted to human bait.

## Key to the Males of the Subgenus Pressatia*

1. Paramere as shown, with about 10 blade-like setae arising from & near ventral margin. ..... L. camposi (Pl. 21-1)
   Paramere otherwise, without such blade-like setae. ..... 2

2. Coxite with median & distal group of persistent setae beyond basal group. ..... L. equatorialis (Pl. 21-2)
   Coxite without median group of persistent setae; basal group present. ..... 3

3. Paramere slender, its width at level of ventral acute projection less than or subequal to width of lateral lobe. Coxite without fine hairs or tubercle above the base of modified setae.... L. dysponeta (Pl. 21-3)
   Paramere otherwise, broader. Coxite with fine hairs inserted on tubercle next to base of modified setae. ..... 4

4. Coxite with only 3-4 slender straight setae inserted on small tubercle above base of modified setae. ..... L. triacantha (Pl. 21-2)
   Coxite with 10 or more such setae inserted on larger tubercle than above. ..... 5

5. Paramere as shown, with apical digitiform process directed upwards. ..... L. calcarata (Pl. 21-2)

---

*It is impossible to construct a useful key to the Pressatia females because there are no structural differences between most of the species.

Paramere otherwise, apical digitiform process pointing posteriorly. ..... 6

6. Paramere with long dorsal setae inserted over distal half of structure, including apical digitiform process. ..... ..... Lutzomyia (Pressatia) n.sp. #1 (Pl. 21-2)

Paramere without long dorsal setae as above. ..... 7

7. Coxite with 8-9 modified setae at base. ..... L. trispinosa (Pl. 21-2)

Coxite with 6 or fewer modified setae at base. ..... L. choti (Pl. 21-2)

## Lutzomyia (Pressatia) camposi (Rodriguez)

Plate 21-1

Phlebotomus camposi Rodriguez 1950 (published in 1952): 7 (♂, Quevedo, Los Rios, Ecuador).

Phlebotomus acanthobasis Fairchild & Hertig 1952: 508 (♂, ♀, Panama); 1958b: 205 (as synonym of camposi).

Lutzomyia camposi: Barretto 1962: 95. Martins et al. 1978: 55 (refs., dist.). Young 1979: 97 (♂, ♀ figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits). Christensen et al. 1983: 466 (Panama). Young & Rogers 1984: 599 (Ecuador). Murillo & Zeledón 1985: 43 (♂, ♀ figs., Costa Rica).

Pressatia camposi: Forattini 1971a: 106 (listed); 1973: 512 (♂, ♀ figs., tax.)

Distribution (Map 21-1). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979); Ecuador (Martins et al. 1978; Young 1979; Young & Rogers 1984).

Remarks. Hanson (1968) described the fourth instar larva of L. camposi. This species and L. dysponeta occur together in many localities; the females are distinguished by the longer individual sperm ducts of L. camposi.

## Lutzomyia (Pressatia) equatorialis (Mangabeira)

Plate 21-2

Flebotomus equatorialis Mangabeira 1942a: 127 (♂, Aurá, Belém, Pará, Brazil).

Lutzomyia equatorialis (or aequatorialis): Barretto 1962: 95. Theodor 1965: 192. Leger et al. 1977: 227 (♂ fig., French Guiana). Martins et al. 1978: 56 (Brazil records). Ryan 1986: 84 (♂ fig.). Lebbe et al. 1987: 29 (computer aided ident.).

Pressatia equatorialis: Forattini 1971a: 106 (listed); 1973: 517 (♂ fig., tax.).

Distribution (Map 21-2). French Guiana (Leger et al. 1977); Brazil (Martins et al. 1978; Ryan 1986).

Remarks. The male of L. equatorialis differs from other Pressatia males by the presence of a median group of setae on each coxite. The female remains undescribed.

## Lutzomyia (Pressatia) dysponeta (Fairchild & Hertig)

Plate 21-3

Phlebotomus dysponetus Fairchild & Hertig 1952: 505 (♂, ♀, Juan Mina, Canal Zone, Panama).

Phlebotomus triacanthus (not triacanthus Mangabeira): Rodriguez 1950 (published in 1952): 6 (Ecuador).

Lutzomyia dysponeta: Barretto 1962: 95. Martins et al. 1978: 55 (refs., dist.). Young 1979: 98 (♂, ♀ figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits, Panama). Christensen et al. 1983: 466 (Panama). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 43 (♂, ♀ figs., Costa Rica).

Pressatia dysponeta: Forattini 1971a: 106; 1973: 515 (♂, ♀ figs., tax.).

Distribution (Map 21-2). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979); Ecuador (Rodriguez 1950; Young & Rogers 1984); Venezuela (Marmol Leon 1968; Martins et al. 1978).

Remarks. Hanson (1968) described the larvae (first & fourth instars) and pupa of L. dysponeta. The fourth instar larvae of this species and L. camposi cannot be distinguished (in key, Hanson 1968). Thatcher (1968b) collected larvae in Panama, 6 m above ground level in dead leaves in a tree and Rutledge & Ellenwood (1975a) captured an adult in a soil emergence trap, placed on the forest floor, also in Panama.

## Lutzomyia (Pressatia) triacantha (Mangabeira)

Plate 21-2

Flebotomus triacanthus Mangabeira 1942a: 119 (♂, Aurá, Belém, Pará, Brazil); 1942c: 242 (♀, immatures).

Lutzomyia triacantha: Barretto 1962: 95 (listed). Theodor 1965: 192 (♂, ♀ figs.). Leger et al. 1977: 226 (French Guiana). Martins et al. 1978: 56 (refs., dist.). Feliciangeli 1980: 246 (Venezuela). Llanos 1981: 183 (Peru). Biancardi et al. 1982: 173 (Rondonia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 85 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Pressatia triacantha: Forattini 1971a: 107; 1973: 520 (♂, ♀ figs., tax.).

Distribution (Map 21-3). Venezuela (Pifano et al. 1962, no locality given; Feliciangeli 1980). Colombia (Osorno et al. 1972a); Brazil; Peru (Martins et al. 1978).

Remarks. Records of L. triancantha in Colombia and Venezuela, cited above, are questionable and must be confirmed when males are obtained. The male illustrated by Young (1979) from Ecuador (also Young & Rogers 1984) is conspecific with L. choti, not L. triacantha.

We have examined 2 triacantha males identified by O. Mangabeira and collected by him from the type locality.

## Lutzomyia (Pressatia) calcarata Martins & Silva

Plate 21-2

Lutzomyia calcarata Martins & Silva 1964: 131 (♂, Seringal, Carioca, Acre, Brazil). Llanos et al. 1975b: 669 (Peru); 1976: 483 (♀). Martins et al 1978: 53 (dist., refs.). Llanos 1981: 183 (Peru). Biancardi 1982: 173 (Rondonia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil).

Lutzomyia sp. E Velasco 1973: 89 (♂♂, ♀, Huacakarita & Tajlewi, Yungas, Bolivia).

Pressatia calcarata: Forattini 1971a: 106 (listed); 1973: 512 (fig., tax.).

Distribution (Map 21-2). Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982); Peru (Llanos 1981); Bolivia (Velasco 1973).

## Lutzomyia (Pressatia) n. sp. #1

Plate 21-2

Lutzomyia sp. D Velasco 1973: 88 (♂, Huacakarita, Yungas, Bolivia).

Distribution (Map 21-4). Bolivia (Velasco 1973); ? Colombia (Young & Morales 1987).

Remarks. This species, known from a single male, is easily distinguished from other Pressatia males by the presence of long setae on the dorsum of the paramere. It has not been assigned a formal name owing to the lack of material.

A Pressatia male, figured by Young & Morales (1987), from Colombia closely resembles the Bolivian sp. but it is not a complete specimen. Its status has not been determined.

## Lutzomyia (Pressatia) trispinosa (Mangabeira)

Plate 21-2

Flebotomus trispinosus Mangabeira 1942a: 127 (♂, Aurá, Belém, Pará, Brazil).

Lutzomyia trispinosa: Barretto 1962: 95. Theodor 1965: 192. Leger et al. 1977: 227 (♂ figs., French Guiana). Martins et al. 1978: 56 (dist.). Ryan 1986: 86 (♂ fig., Brazil records).

Pressatia trispinosa: Forattini 1971a: 107; 1973: 514 (in part, as junior synonym of choti).

Distribution (Map 21-4). French Guiana (Leger et al. 1977); Brazil (Martins et al. 1978; Ryan 1986).

Remarks. Forattini (1973) treats L. trispinosa as a synonym of L. choti but this proposal has not been accepted because of salient differences in the shape of the parameres and number of persistent setae of the coxite turf (Leger et al. 1977).

We studied one topotype male of L. trispinosa identified by O. Mangabeira.

## Lutzomyia (Pressatia) choti (Floch & Abonnenc)

Plate 21-2

Phlebotomus choti Floch & Abonnenc 1941a: 7 (♂, ♀, Montjoly, French Guiana); 1952: 64 (figs.).

Lutzomyia choti: Barretto 1962: 95 (listed). Theodor 1965: 192 (listed). Llanos 1973: 34 (♂, Peru). Leger et al. 1977: 226 (♂ fig., French Guiana). Martins et al. 1978: 53 (refs., dist., figs.). Llanos 1981: 183 (Peru). Arias & Freitas 1982: 403 (Acre, Brazil). Ready et al. 1983: 780 (♀, Pará, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 83 (♂, ♀ figs., Pará, Brazil). Lebbe

et al. 1987: 29 (computer aided ident.). Young & Morales 1987: 662 (Colombia).

Pressatia choti: Forattini 1971a: 106 (listed); 1973: 514 (in part).

Pressatia triacantha (not triacanthus Mangabeira): Young 1979: 100 (♂ fig., Ecuador). Young & Rogers 1984: 599 (listed Ecuador).

Distribution (Map 21-1). French Guiana (Leger et al. 1977; Martins et al. 1978); Brazil (Martins et al. 1978; Arias & Frietas 1982; Ryan 1986); Colombia (Young & Morales 1987); Ecuador (Young 1979); Peru (Llanos 1981); Suriname (♂♂, Aseli Kamp & Putamakko 1979, 1983, A.M. Burgos).

Remarks. We compared a L. choti male from French Guiana, identified by H. Floch, with males from Ecuador (Young 1979) and Colombia (Young & Morales 1987) and concluded that they were conspecific.

Lutzomyia choti has been commonly found resting in armadillo burrows in Pará State, Brazil (Ready et al. 1983).

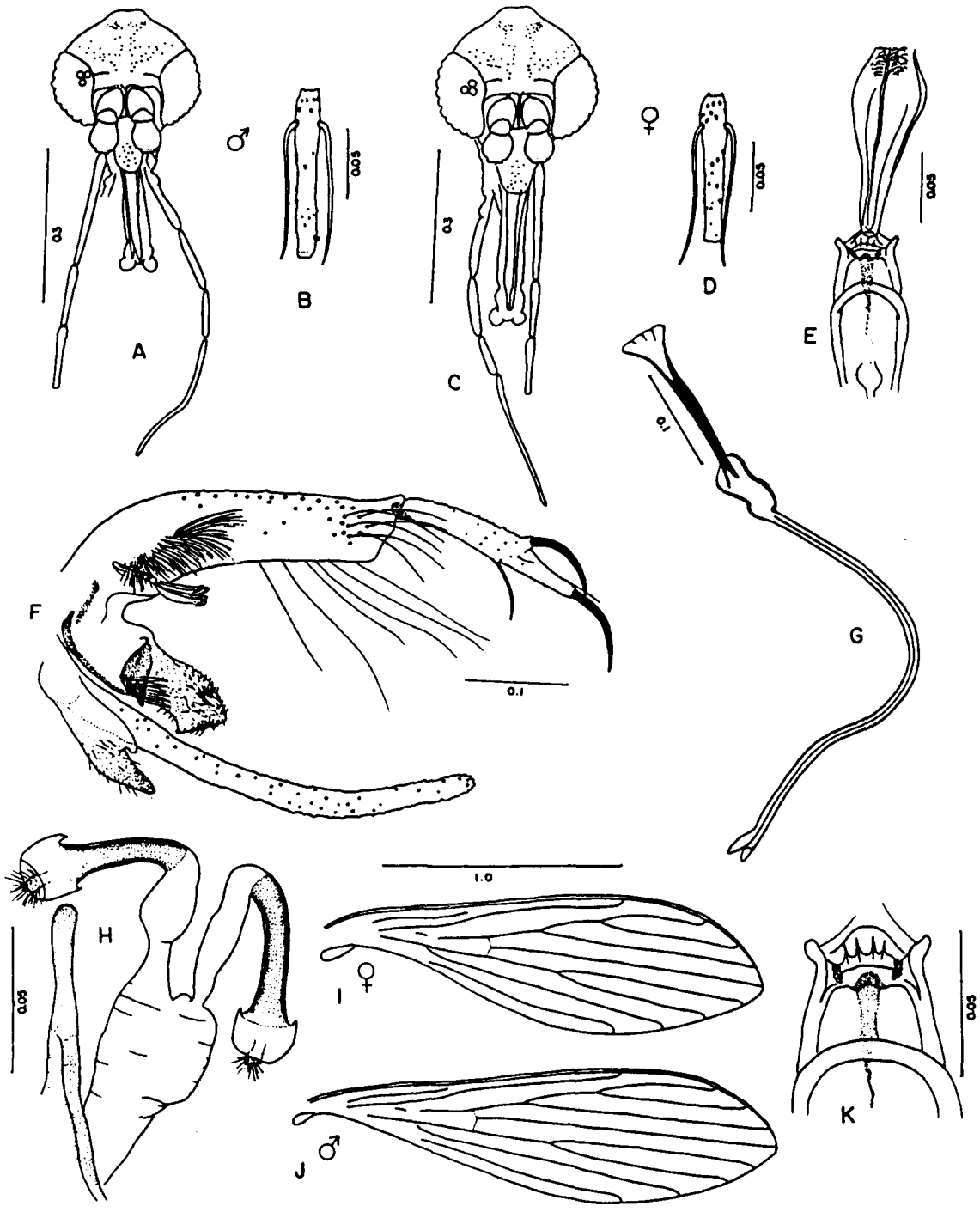



Plate 21-1

Lutzomyia camposi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

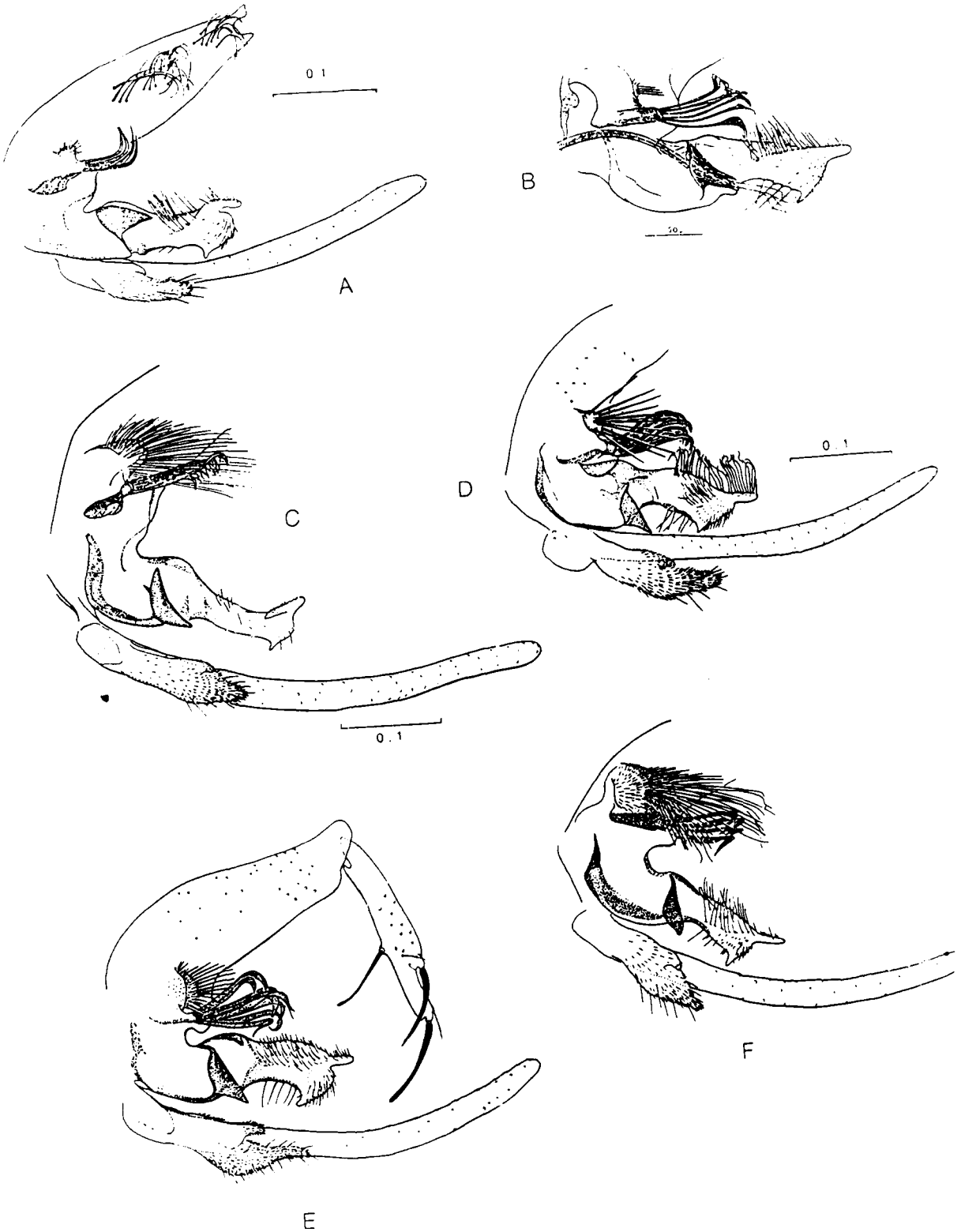



Plate 21-2

Lutzomyia equatorialis. A. Male terminalia, in part.

Lutzomyia triacantha. B. Paramere & coxite base (from Mangabeira 1942a).

Lutzomyia calcarata. C. Male terminalia, in part.

Lutzomyia (Pressatia) n.sp. #1. D. Male terminalia, in part.

Lutzomyia trispinosa. E. Male terminalia

Lutzomyia choti. F. Male terminalia, in part.

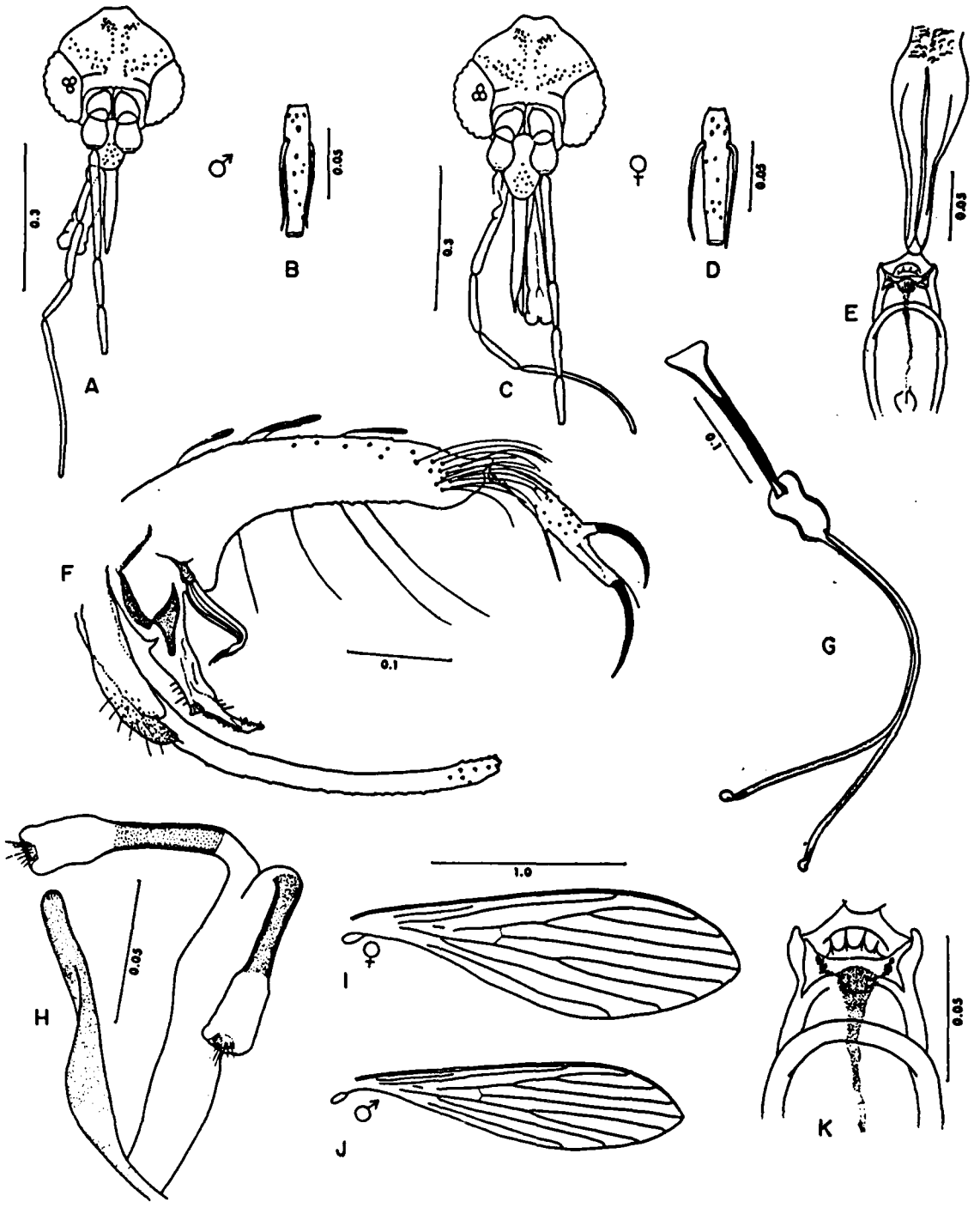
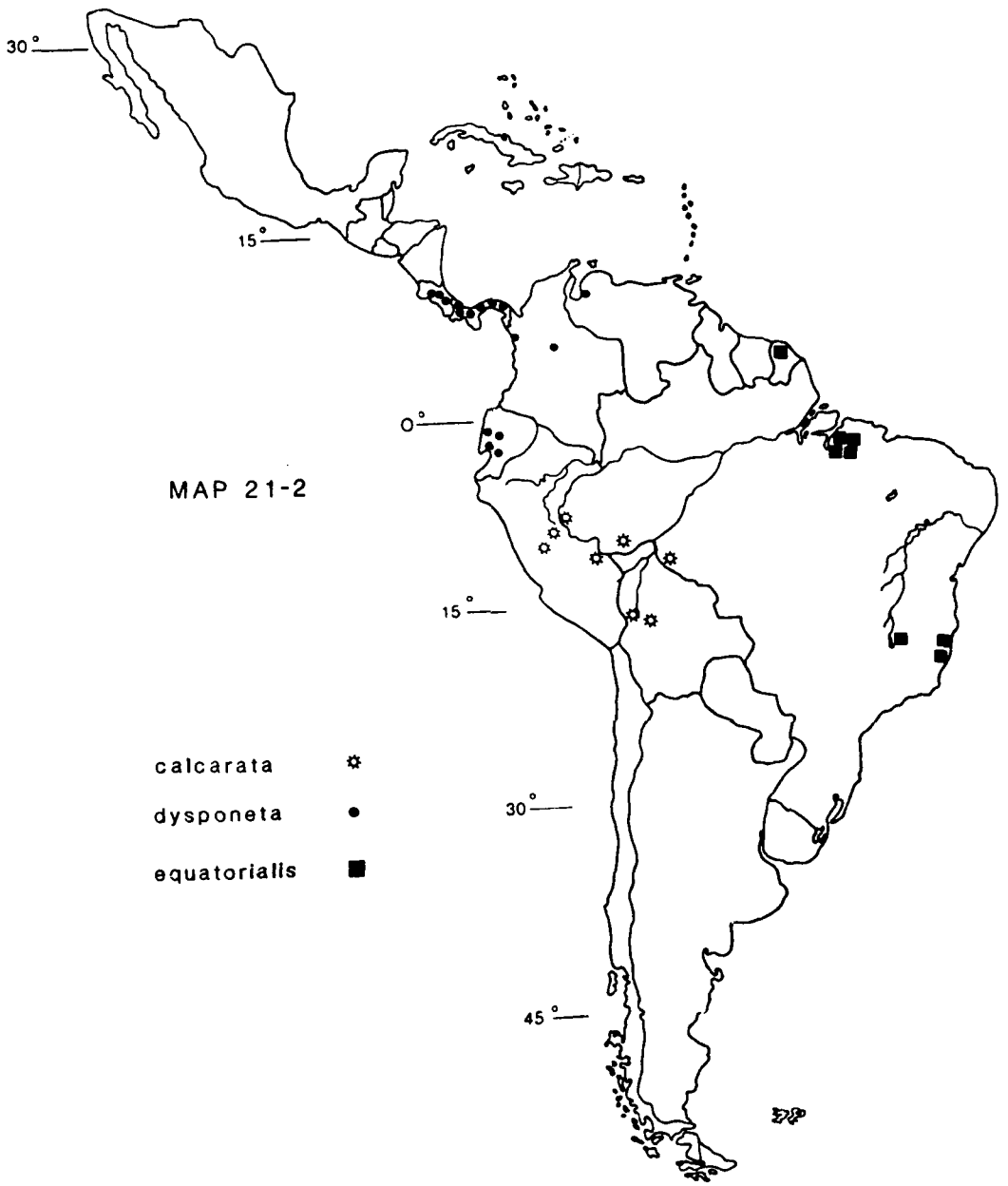



Plate 21-3

Lutzomyia dysponeta. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).


30°
15°
0°
15°
30°
45°
MAP 21-1
camposi
choti




MAP 21-2




MAP 21-3

triacantha ◑


30°
15°
0°
15°
30°
45°
?
MAP 21-4
trispinosa
L. (Pressatia) n.sp. #1

## 22. *Lutzomyia* Species Group *Baityi*

*Lutzomyia* species group *baityi* Theodor 1965: 194. Lewis et al. 1977: 325.

*Lutzomyia* subgenus *Coromyia* (in part): Forattini 1971a: 101.

*Lutzomyia* species group *gorbitzi*: Martins et al. 1978: 156.

*Identification*. Coloration dusky, scutum lightly to moderately pigmented. Flagellomere I shorter than proboscis; ascoids simple. Palpomere 5 long, subequal to combined length of palpomeres 2 + 3 + 4. ♀ cibarium with 4 pointed horizontal teeth; complete arch & well-defined pigment patch. Pharynx unarmed. Spermathecae tubular, with short to long individual ducts; common duct short or absent. ♂ *genitalia*: Coxite with distal row or group of 4-18 long setae; basal tuft present or absent. Style with 4 short, thick spines & subterminal seta. Genital filaments shorter than 3X pump length. Lateral lobes shorter than coxite length & with tapered ends.

The *baityi* group males, like those in the *dreisbachi* group, have long persistent setae at the distal part of each coxite but the antennal ascoids are simple and a small subterminal seta is present on each style.

*Medical Importance*. Unknown. Females have not been reported attacking man.

Key to males of the species group *baityi*

1. Style with 4 spines at distal third of segment. Coxite with patch of very short setae at base. ..... *L. gorbitzi* (Pl. 22-1)

   Style with proximal isolated spine near middle of segment. Coxite with or without persistent basal setae; if present they are longer than width of coxite. ..... 2

2. Coxite with basal group of 4-6 long setae. Genital filaments about 2X length of pump & with modified tips. ..... *L. baityi* (Pl. 22-2)

   Coxite with basal group of setae. Genital filaments longer (ca. 2.6X length of pump) & having simple tips. ..... *L. moucheti* (Pl. 22-3)

Key to females of species group *baityi*

1. Spermathecae with terminal knob multilobed; individual ducts long, exceeding length of genital fork stem. ..... *L. moucheti* (Pl. 22-3)

   Spermathecae with terminal knob unilobed; individual ducts shorter than genital fork stem. ..... *L. gorbitzi* (Pl. 22-1)
   *L. baityi**

*Undescribed but probably conspecific with female illustrated by Martins et al. (1978).

## Lutzomyia baityi (Damasceno, Causey & Arouck)

Plate 22-2

Flebotomus baityi Damasceno, Causey & Arouck 1945: 22 (o, Cuiteua, Irituia, Pará, Brazil).

Lutzomyia baityi: Theodor 1965: 194. Forattini 1973: 281. Martins et al. 1978: 158 (? ♀ figs., refs.). Young 1979: 102 (♂ fig., refs.). Feliciangeli 1980: 246 (Venezuela). Young & Rogers 1984: 599 (listed, Ecuador). Ryan 1986: 25 (♂ fig.).

Distribution (Map 22-1). Brazil (Martins et al. 1978; Ryan 1986); Colombia and Ecuador (Young 1979); Venezuela (Martins et al. 1978).

## Lutzomyia gorbitzi (Blancas)

Plate 22-1

Phlebotomus gorbitzi Blancas 1959/1960: 125 (♂, ♀, Canon del Pato, Ancash, Peru).

Phlebotomus hansoni Fairchild & Hertig 1961b: 244 (♂, ♀, Panama). Hanson 1968: 62 (larva, Panama).

Lutzomyia hansoni: Theodor 1965: 194 (♂, ♀, figs.). Christensen & Rutledge 1973: 314 (junior synonym of gorbitizi).

Lutzomyia gorbitzi: Theodor 1965: 194. Forattini 1971a: 101; 1973: 286. Martins et al. 1978: 158. Christensen et al. 1983: 466 (rel. abundance in Panama). Murillo & Zeledon 1985: 121 (♂, ♀ figs., Costa Rica).

Distribution (Map 22-1): Costa Rica (Murillo & Zeledon 1985); Panama, Peru (Martins et al. 1978).

Remarks: Most specimens of L. gorbitzi in Panama have been aspirated from tree trunks or hollows that are sometimes occupied with bats (Christensen et al. 1983). The feeding habits of this species have not been studied.

Hanson (1968) collected, reared and described larvae of L. gorbitzi that he recovered from soil between buttressed roots in Panama.

Lutzomyia moucheti Pajot & Le Pont

Plate 22-3

Lutzomyia moucheti Pajot & Le Pont 1978: 295 (♂, French Guiana). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 22-1). French Guiana (Pajot & Le Pont 1978); Peru (♂, ♀, Madre de Dios, Tambopata Reserve, canopy fogging collections, T. Erwin); Brazil (♂, Amazonas, Balbina Hydroelectric Dam, NE of Manaus, canopy light trap, J. Arias).

Remarks. The description of the previously unknown female from Tambopata Reserve, Peru, is given below.

♀ (n = 1). Wing length 1.32; width 0.36. Whole insect moderately pigmented but scutum darker than pleura. Head height 0.35; width 0.27. Eyes small, separated by 0.13 or by distance = to 9 facet diameters. Flagellomere I, 0.11 long; II & III = 0.14 long; ascoids simple, those on II extending to end of segment; on all flags, except last flag. (XIV). Labrum 0.21 long. Length of palpomeres: 1, 0.03; 2, 0.09; 3, 0.12; 4, 0.09; 5, 0.22; palpal sensilla (ca. 8) visible on middle 1/2 of palp. 3, scattered. Cibarium with 4 sharp equidistant horizontal teeth & transverse row of 7 small vertical teeth; pigment patch as shown, moderately infuscated; arch complete. Pharynx unarmed, 0.14 long. Pleura with 5-7 & 3 lower episternal setae. Length of wing vein sections: alpha, 0.23; beta, 0.24; delta, 0.02-0.03; gamma, 0.18-0.20. Length of femorae, tibiae & basitarsi: foreleg, 0.50, 0.45, 0.25; midleg, 0.52, 0.52, 0.31; hindleg, 0.56, 0.68. 0.35. Spermathecae slightly wider than individual ducts, with incipient annuli, terminal knob not distinct, apparently embedded into spermathecae & divided. Common sperm duct very short.

Remarks. The female of L. moucheti was associated with the male on the basis of its very small eyes, short flagellomeres, length of palpomeres, coloration and wing venation. Both specimens from Peru, as well as the males from Brazil and French Guiana, were taken in the forest canopy, suggesting that L. moucheti is a true canopy dwelling species.

The distinctive spermathecae and, particularly, the multilobed terminal knob, serve to distinguish the L. moucheti females from others in the genus.

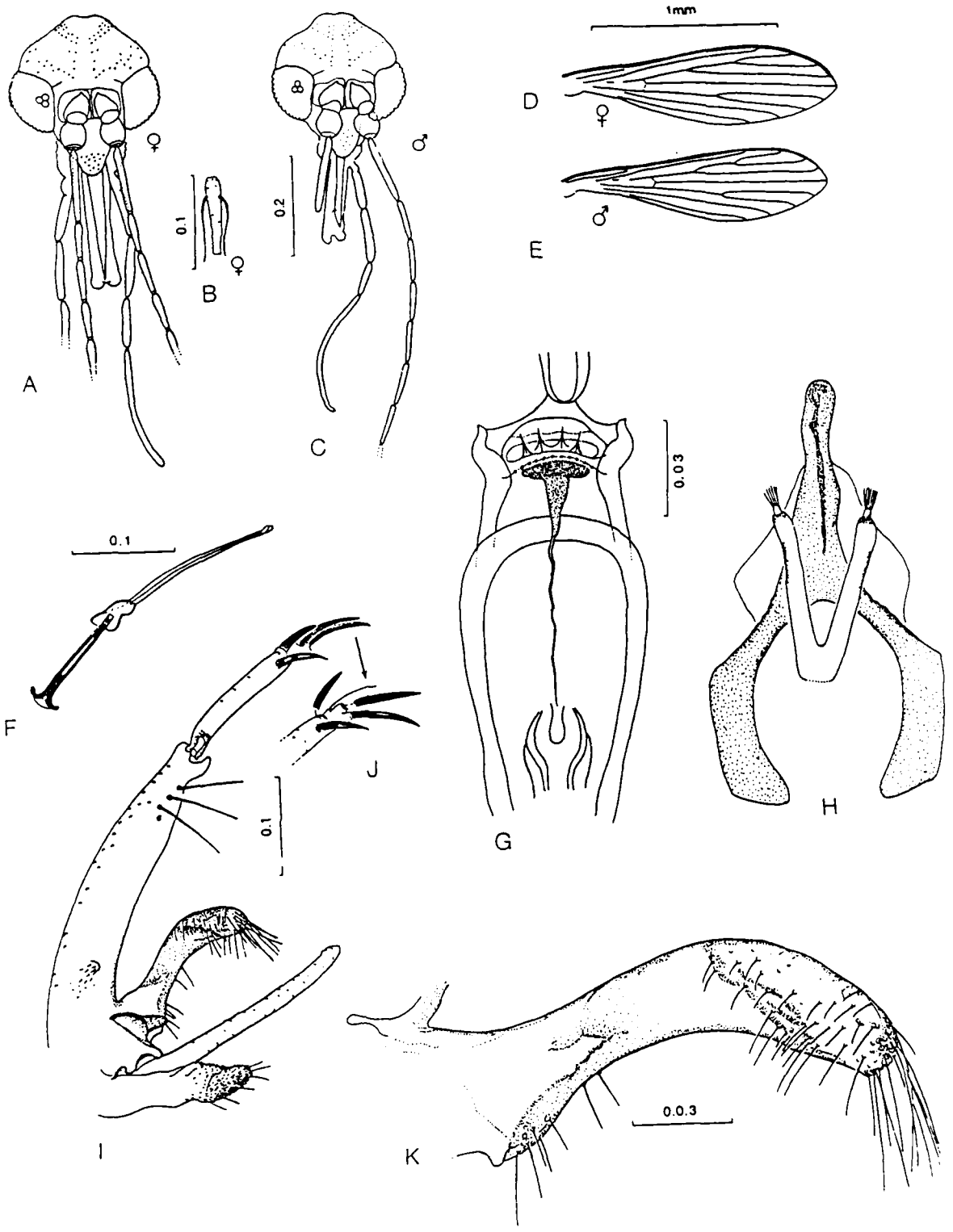



Plate 22-1

Lutzomyia gorbitzi. A. Female head; B. Female flagellomere II; C. Male head; D. Female wing; E. Male wing; F. Gential pump & filaments; G. Female cibarium; H. Spermathecae; I. Male terminalia; J. Apex of style, different angle of view; K. Paramere.

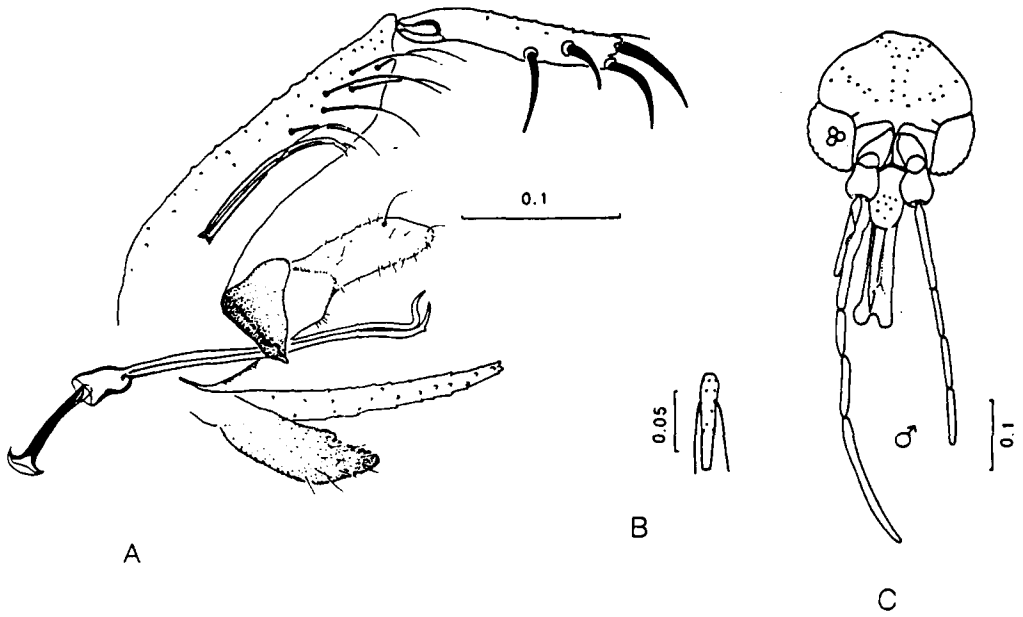



Plate 22-2

Lutzomyia baityi. A. Male terminalia; B. Male flagellomere II; C. Male head (Fig. A from Young 1979)

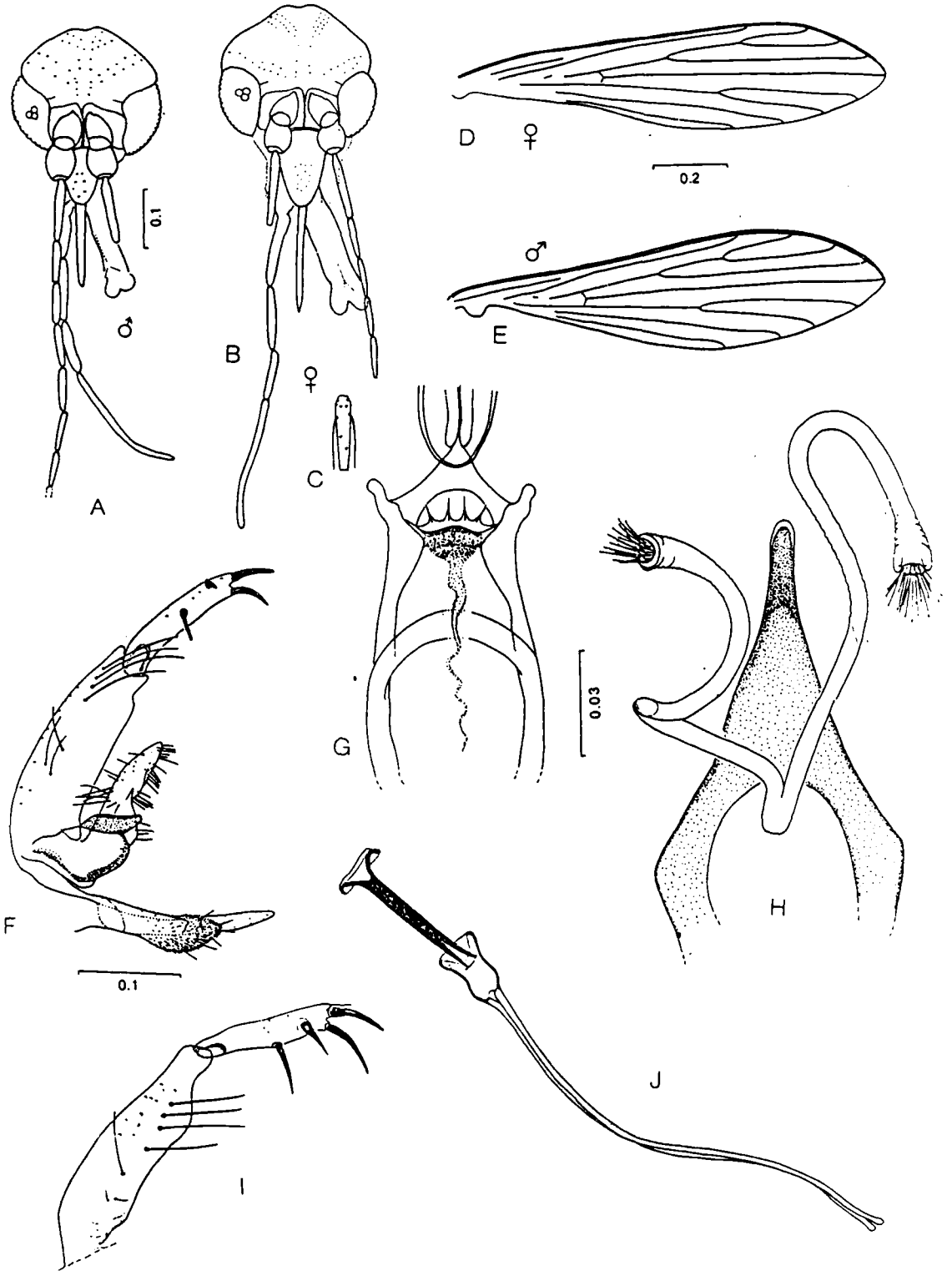
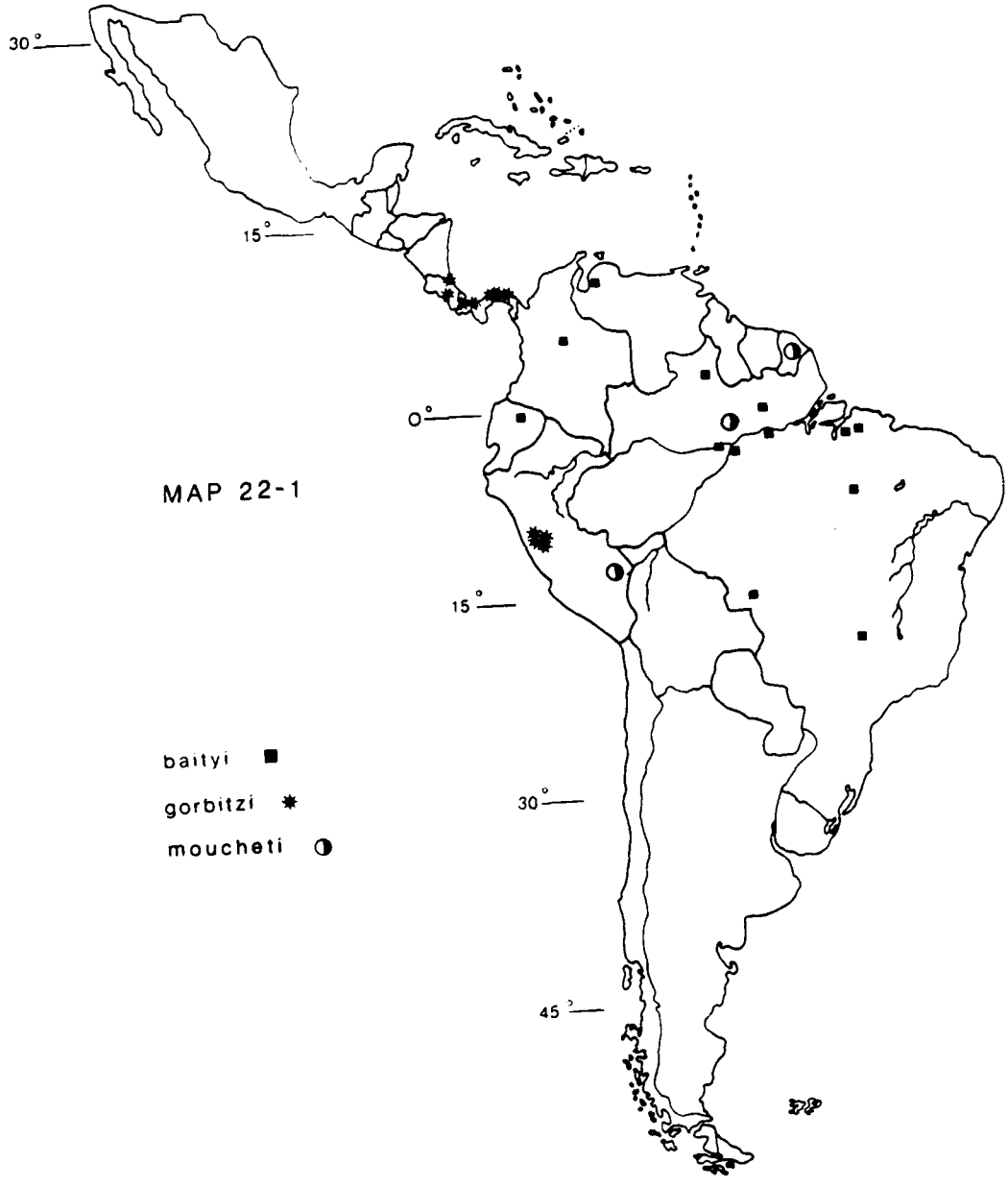



Plate 22-3

Lutzomyia moucheti. A. Male head, B. Female head, C. Female flagellomere II, D. Female wing, E. Male wing, F. Male terminalia, G. Female cibarium, H. Spermathecae, I. Male coxite & style, J. Genital pump & filaments.




MAP 22-1

## 23. Lutzomyia Subgenus Evandromyia Mangabeira

Lutzomyia subgenus Evandromyia Mangabeira 1941b: 349 (type species: Flebotomus infraspinosus Mangabeira by orig. designation). Barretto 1962: 93 (defined). Theodor 1965: 190 (defined). Young & Arias 1977: 59 (review). Martins et al. 1978: 29 (defined).

Identification. Coloration pale to dark brown. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. Eyes relatively small. ♀ cibarium with 4 equidistant horizontal teeth & complete arch. Pharynx unarmed. Spermathecae sac-like or tubular. ♂ genitalia; Coxite with persistent setae at base. Style with 4 spines & subterminal seta. Paramere simple, bifurcate (series infraspinosa) or trifurcate (series monstruosa). Aedeagus with ventral extension or process (series monstruosa) or simple (series infraspinosa). Lateral lobe with 2-4 long spatulate setae at tip (series infraspinosa) or lacking such setae (series monstruosa).

Medical Importance. Unknown; females are not readily attracted to human bait.

### Key to the males of the subgenus Evandromyia

1. Paramere undivided or bifurcate. Lateral lobe with dorsal spatulate setae at tip. Aedeagus simple (infraspinosa complex). ..... 2

   Paramere trifurcate. Lateral lobe without dorsal spatulate setae. Aedeagus with long ventral extension (monstruosa complex). ..... 8

2. Paramere undivided. ..... 3

Paramere bifurcate. ..... 4

3. Lateral lobe with 4 spatulate setae. Paramere relatively broad & slightly upturned. ..... L. pinottii (Pl. 23-4)

Lateral lobe with 3 spatulate setae. Paramere more slender, not upturned. ..... L. bourrouli (Pl. 23-3)

4. Style with short spines, all inserted at distal third of segment. Coxite with 7-8 short setae grouped on an inconspicuous tubercle at inner base. ..... L. cerqueirai (Pl. 23-7)

Style with longer spines, one or more of which inserted at proximal third of segment. Coxite with persistent setae longer than width of style. ..... 5

5. Lateral lobe with 2 spatulate setae. Coxite tuft of 4-6 setae. .....
..... L. brachyphalla (Pl. 23-6)

Lateral lobe with 3 spatulate setae. Coxite tuft of 10+ setae. ..... 6

6. Genital filaments very thick, especially near end. Paramere as shown. ..... L. inpai (Pl. 23-5)

Genital filaments much thinner. Paramere otherwise. ..... 7

7. Paramere with acute projection on lower, ventral arm. .....
..... L. begonae (Pl. 23-2)

Paramere without acute projection on lower ventral arm. .....
..... L. infraspinosa (Pl. 23-1)

8. Aedeagus with ventral extension longer than dorsal part, more or less sinuous. Coxite setal tuft or 6-7 setae. Paramere as shown. .....
..... L. monstruosa (Pl. 23-8)
Aedeagus with much shorter ventral extension, ending well before apex of dorsal part. Coxite setal tuft of ca. 12 setae. Paramere otherwise. ..... L. teratodes (Pl. 23-9)

Key to the females of the subgenus Evandromyia

1. Spermatheca short & stout, its width nearly equal to its length. .... 2
Spermathecae 2 or more times longer than wide. ..... 3

2. Individual sperm ducts long, about 3x length of spermatheca. .....
..... L. cerqueirai (Pl. 23-7)
Individual sperm ducts apparently absent; spermathecae appear to attach directly to common duct. ..... L. inpai (Pl. 23-5)

3. Pleura & scutum heavily pigmented. ..... L. pinottii (Pl. 23-4)
L. bourrouli
Pleura & scutum pale or only lightly pigmented. ..... 4

4. Spermathecae and common duct subequal in width. .....
..... L. brachyphalla (Pl. 23-6)

Spermathecae considerably more slender than common duct, visible or not. ..... 5

5. Spermatheca curved apically like an inverted "J"; individual ducts with a median or distal transverse constriction. ..... 6
Spermathecae not as above; individual ducts without such a constriction. ..... L. infraspinosa (Pl. 23-1)
L. begonae (Pl. 23-2)

6. Individual sperm ducts and spermathecae subequal in width. ..... L. teratodes (Pl. 23-9)
Individual sperm ducts obviously much thinner than width of spermathecae. ..... L. monstruosa (Pl. 23-8)

Infraspinosa complex

Lutzomyia (Evandromyia) infraspinosa (Mangabeira)

Plate 23-1

Flebotomus infraspinosus Mangabeira 1941b: 216 (♂, Aura, Belém, Pará Brazil). Barretto 1947a: 204 (full refs.).

Lutzomyia infraspinosa: Young & Arias 1977: 61 (full refs.). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 33 (refs, dist.). Lainson et al. 1979: 241 (neg. for flagellates, Brazil). Leger et al. 1980: 116 (French Guiana). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Hudson & Young 1985:

418 (Suriname). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ready et al. 1986: 29 (Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 33 (figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil). Lebbe et al. 1978: 28 (computer aided ident.).

Distribution (Map 23-1). French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Suriname (Martins et al. 1978; Hudson & Young 1985); Brazil (see refs. in species bibliography); ? Peru (Young et al. 1985); Colombia (♂♂, Leticia, Amazonas, 1987, A. Morales).

Remarks. Females from SE Peru & Ecuador resemble L. infraspinosa, but males are needed to confirm the identifications (Young et al. 1985 and Young & Rogers 1984).

Lutzomyia (Evandromyia) begonae (Ortiz & Torres)

Plate 23-2

Phlebotomus begonae Ortiz & Torres 1975: 101 (♂, El Gavilan, Amazonas, Venezuela).

Lutzomyia begonae: Young & Arias 1977:63 (♂, ♀, Manaus, Amazonas, Brazil). Arias & Freitas 1977: 511 (coll. data, Amazonas, Brazil); 1978L 391 (negative for flagellates, Brazil). Feliciangeli 1980: 246 (listed). Biancardi et al. 1982: 168 (? Rondonia, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Young & Morales 1987: 664 (? Colombia).

Distribution (Map 23-2). Venezuela (Ortiz & Torres 1975); Brazil (Young & Arias 1977; Biancardi et al. 1982).

Remarks. There is variation in paramere structure of L. begonae males from Venezuela (Pl. 23-2) and Brazil (Young & Arias 1977). The significance of these differences is not yet known; females and additional males from these and other localities are needed to help determine if these geographic variants should be assigned formal names.

## Lutzomyia (Evandromyia) bourrouli (Barretto & Coutinho)

Plate 23-3

Phlebotomus bourrouli Barretto & Coutinho 1941e: 227 (♂, ♀, Palmeiras, São Paulo, Brazil).

Lutzomyia bourrouli: Forattini 1973: 208 (as senior synonym of L. pinottii). Young & Arias 1977: 60 (full refs.). Martins et al. 1978: 31 (in part, refs., figs.). Arias & Freitas 1982a: 404 (Acre, Brazil). Ryan 1986: 36 (as distinct species).

Distribution (Map 23-3). Brazil (Martins et al. 1978, in part).

Remarks. Ryan (1986) compared the holotype and allotype ♀ of L. bourrouli with specimens of L. pinottii and noted that the bourrouli male has 3 spatulate setae on each lateral lobe. There are 4 such setae on the lateral lobe of L. pinottii. The females, although similar in coloration and structure, can be distinguished by Ryan (op. cit.) by the

relative lengths of the common ducts; that of L. pinottii is longer than the duct of L. bourrouli. We have not examined females referable to L. bourrouli from the type locality or nearly localities.

## Lutzomyia (Evandromyia) pinottii (Damasceno & Arouch)

Plate 23-4

Flebotomus pinottii: Damasceno & Arouck 1956: 2 (♂, Rio Capim, Pará, Brazil).

Lutzomyia aroucki: Barretto 1962: 93 (unnecessary new name for pinottii).

Lutzomyia pinottii: Young & Arias 1977: 65 (refs.). Martins et al. 1978: 31 (as junior synonym of bourrouli). Ryan 1986: 36 (♂, ♀, Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Lutzomyia bourrouli (not bourrouli Barretto & Coutinho): Leger et al. 1980: 116 (French Guiana).

Distribution (Map 23-3). Brazil (Martins et al. 1978, in part; Ryan 1986); French Guiana (Leger et al. 1980).

Remarks. Lucena (1960) assigned the name pinottii to another sandfly species, not pinottii Damasceno & Arouck, and therefore it was a junior homonym. Forattini (1971a) renamed it L. lentiodes but later (1973) considered the species to be a junior synonym of L. lenti

Lutzomyia pinottii (Damasceno & Arouck) is treated as a junior synonym of L. bourrouli by Forattini (1973) and Martins et al. (1978) but following Ryan (1986), we continue to treat the species as distinct. Ryan et al. (1987c) reported a natural trypanosome infection in one of six females of L. pinottii dissected in Pará, Brazil.

## Lutzomyia inpai (Young & Arias)

Plate 23-5

Lutzomyia inpai Young & Arias 1977: 61 (♂, ♀, Amazonas, Brazil). Arias & Freitas 1978; 391 (negative for flagellates, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ready et al. 1986: 29 (Pará, Brazil). Ryan 1986: 34 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 23-4). Brazil (Young & Arias 1977; Ready et al. 1986).

## Lutzomyia (Evandromyia) brachyphalla (Mangabeira)

Plate 23-6

Flebotomus brachyphallus Mangabeira 1941b: 219 (♂, Piratuba, Pará, Brazil). Barretto 1947a: 189 (refs.)

Lutzomyia brachyphalla: Young & Arias 1977: 60 (full refs.). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 31 (refs., dist.). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Geoffroy et

al. 1986: 486 (French Guiana). Ryan 1986: 32 (♀ descript., Pará, Brazil). Lebbe et al. 1087: 28 (computer aided ident.).

Distribution (Map 23-2). French Guiana (Martins et al. 1978); Brazil (Martins et al. 1978; Ryan 1986).

Lutzomyia (Evandromyia) cerqueirai (Causey & Damasceno)

Plate 23-7

Flebotomus cerqueirai Causey & Damasceno 1945b: 42 (♂, Utinga, Belem, Pará, Brazil).

Lutzomyia cerquerai: Young & Arias 1977: 60 (refs.). Martins et al. 1978: 32 (dist., refs.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ryan 1986: 32 (♂ fig., Pará, Brazil). Young & Morales 1987: 658 (♀ descript., ♂ figs., Colombia).

Distribution (Map 23-5). Brazil (Forattini 1973; Martins et al. 1978; Biancardi et al. 1982); Colombia (Young & Morales 1987).

Remarks. Observations of this species near Mariquita, Tolima Dept., Colombia showed that females of L. cerqueirai readily feed on hamsters kept in cages within an open shed in secondary forest (C. Ferro de Carrasquilla, pers. comm.).

Monstruosa complex

Lutzomyia (Evandromyia) monstruosa (Floch & Abonnenc)

Plate 23-8

Phlebotomus monstruosus Floch & Abonnenc 1944a: 1 (♂ , Baduel, French Guiana)

Phlebotomus falciformis Floch & Abonnenc 1944c: 8 (♀, Crique Anguille, French Guiana. Fraiha et al. 1970b: 215 (as ♀ of monstruosa).

Lutzomyia monstruosa: Martins et al. 1964b: 324. Young & Arias 1977: 66 (full refs.). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 33 (dist., refs.). Arias & Freitas 1978: 391 (negative for flagellates, Brazil). Morales & Minter 1981: 96 (Colombia), Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 403 (Acre, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 35 (♂ , ♀ figs., Pará, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan et al. 1987: 356 (nat. flagellate infection, Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Pressatia monstruosa: Forattini 1971a: 103; 1973: 518 (rev., figs.).

Distribution (Map 23-6). Colombia (Morales & Minter 1981); French Guiana (Martins et al. 1978; Leger et al. 1977); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986).

Remarks. This pale, relatively small, sand fly is probably more widespread than present records indicate.

### Lutzomyia (Evandromyia) teratodes Martins, Falcao & Silva

Plate 23-9

Lutzomyia teratodes. Martins, Falcao & Silva 1964b: 321 (♂, Itapaci, Goiás, Brazil). Forattini 1971a: 103. Martins et al., 1975d: 515 (♀ descript.). Young & Arias 1977: 66 (♂ figs., Paraguay). Martins et al. 1978: 33 (♀ figs., dist.).

Pressatia teratodes: Forattini 1973: 518.

Distribution (Map 23-2). Brazil (Martins et al. 1978); Paraguay (Young & Arias 1977).

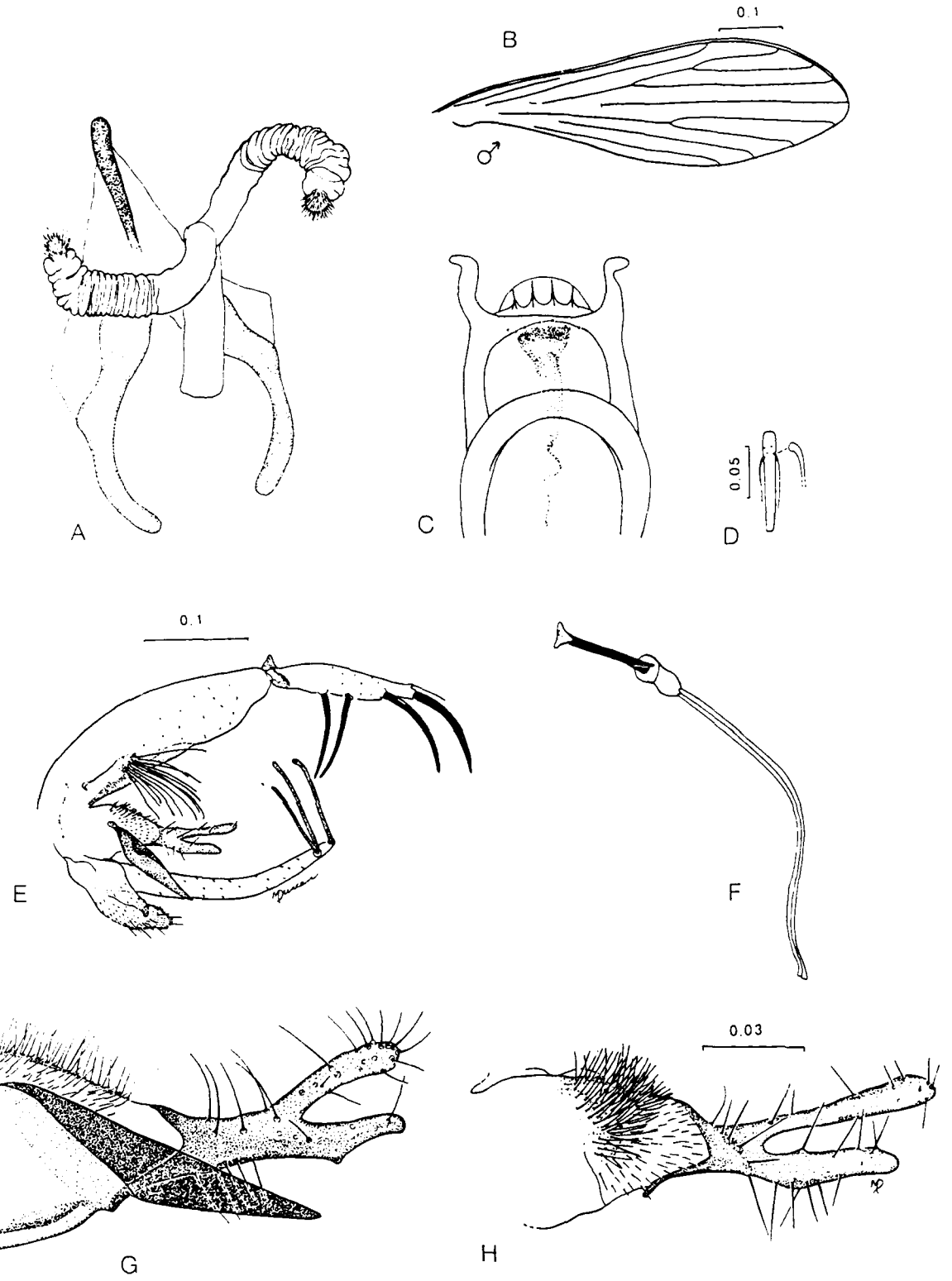



Plate 23-1

Lutzomyia infraspinosa. A. Spermathecae; B. Male wing; C. Female cibarium; D. Female flagellomere; E. Male terminalia; F. Genital pump & filaments; G. Paramere (Leticia, Colombia); H. Paramere (Belém, Brazil).

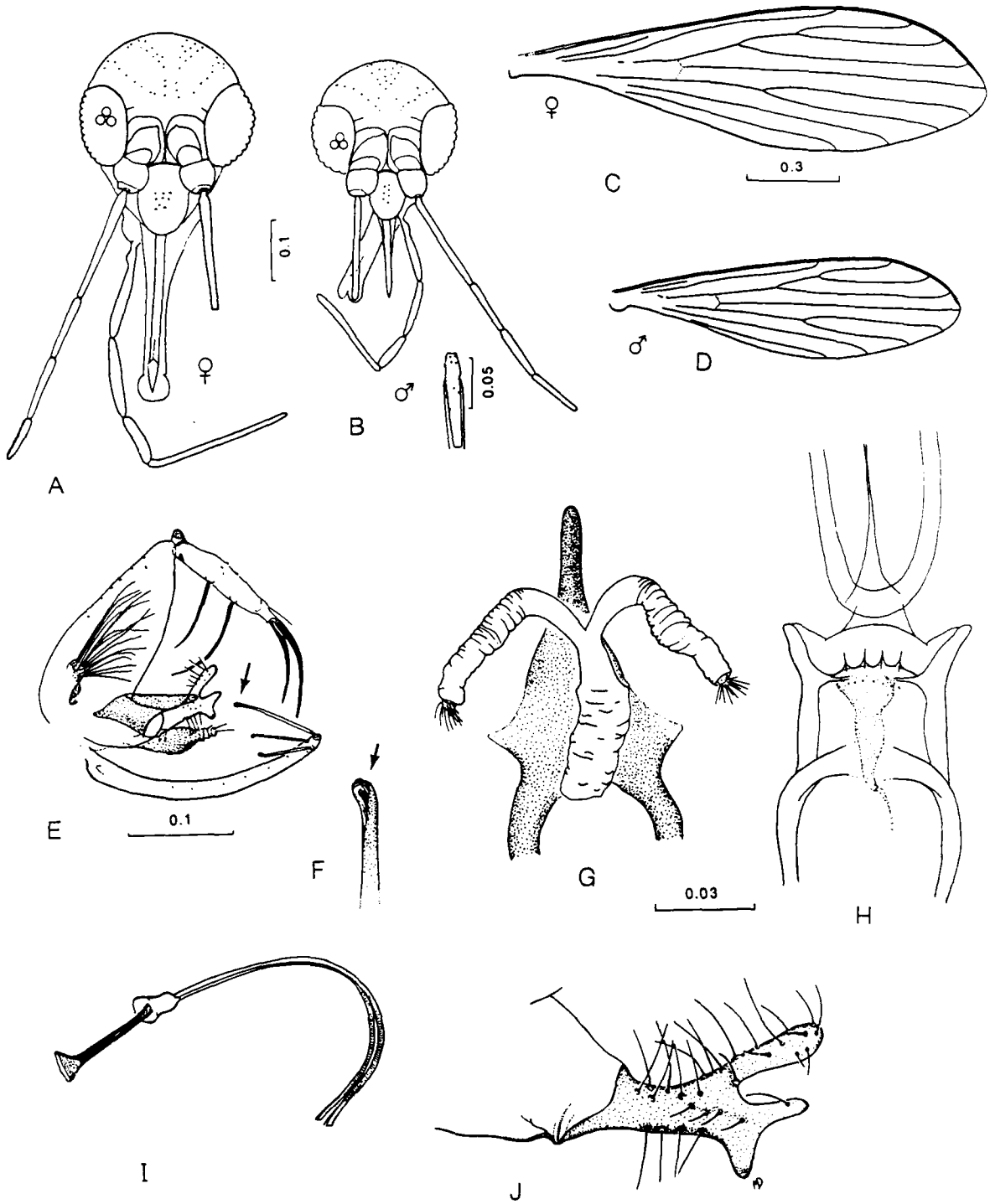



Plate 23-2

Lutzomyia begonae. A. Female head; B. Male head & flagellomere II; C. Female wing; D. Male wing; E. Male terminalia; F. Tip of genital fork; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Paramere.

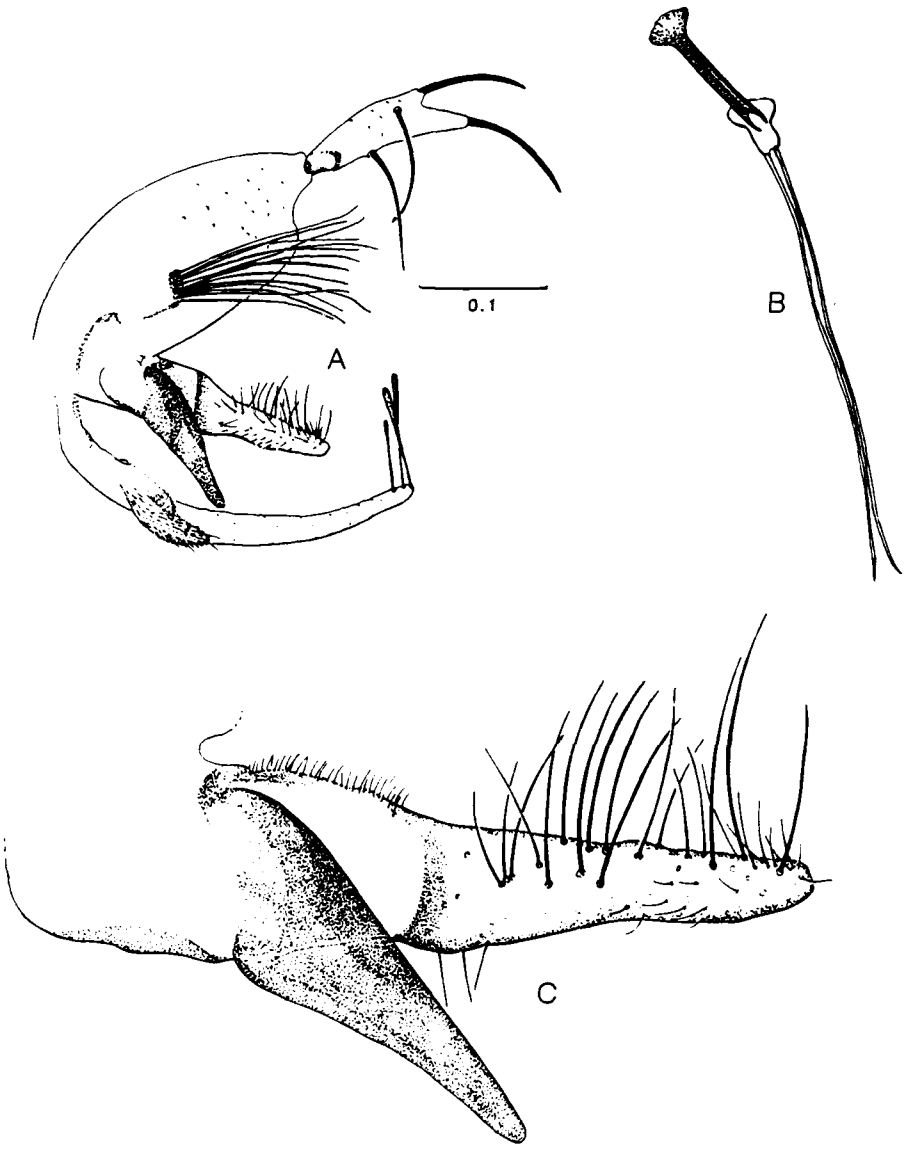



Plate 23-3

Lutzomyia bourrouli. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

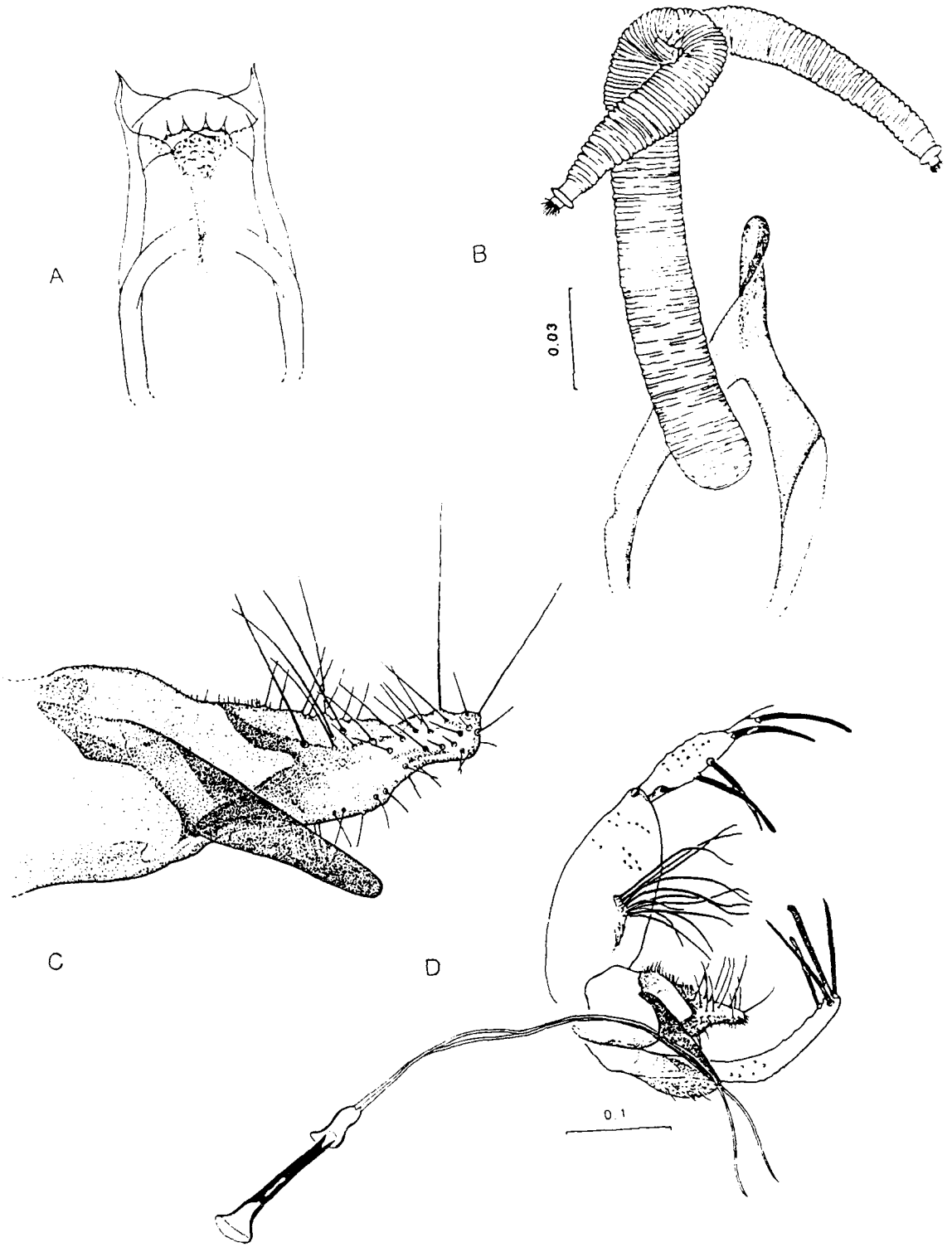



Plate 23-4

Lutzomyia pinottii. A. Female cibarium; B. Spermathecae; C. Paramere; D. Male terminalia.

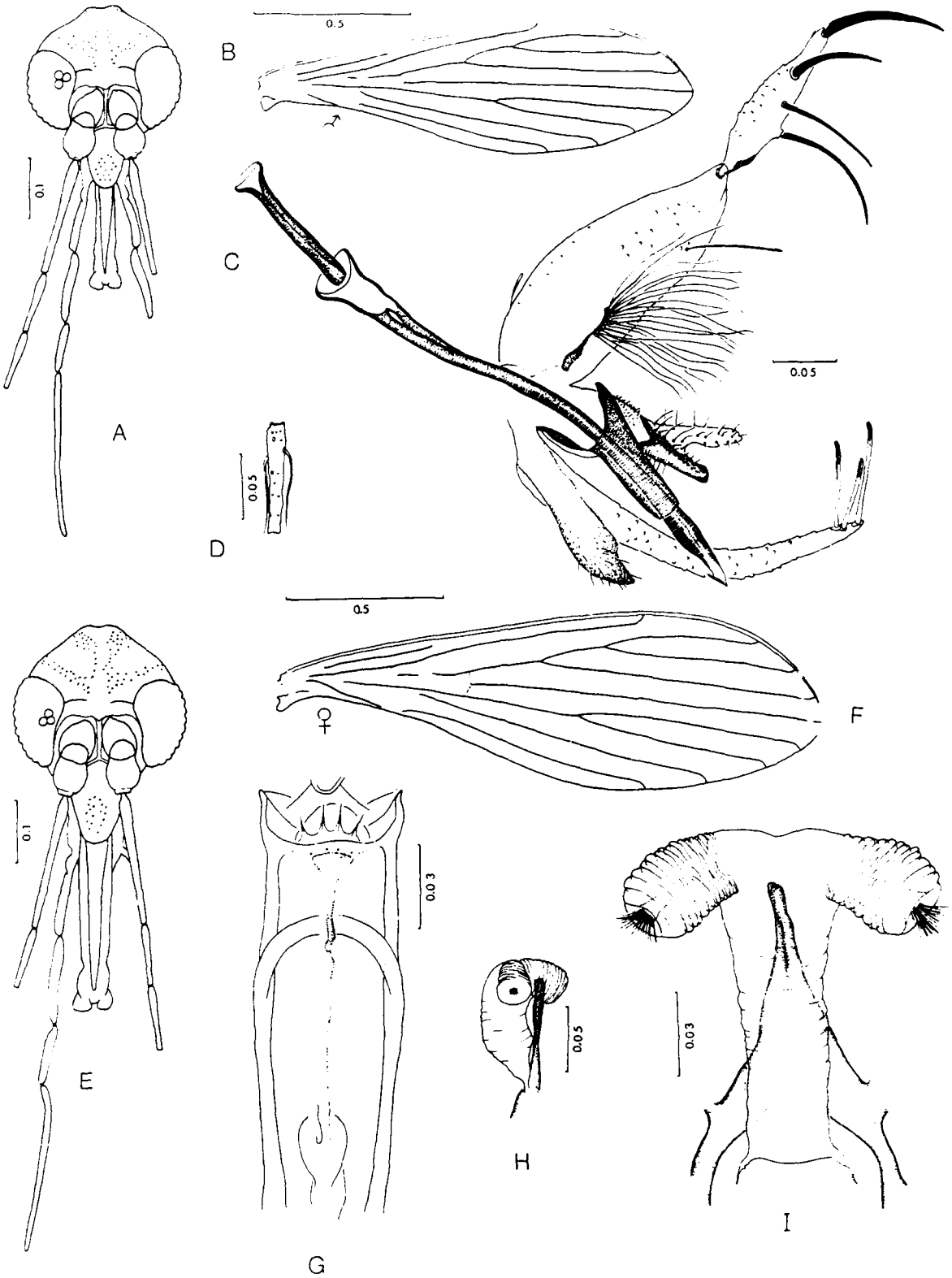



Plate 23-5

Lutzomyia inpai. A. Male head; B. Male wing; C. Male terminalia II; E. Female head; F. Female wing; G. Female cibarium; H. Spermathecae; I. Spermathecae (from Young & Arias 1977).

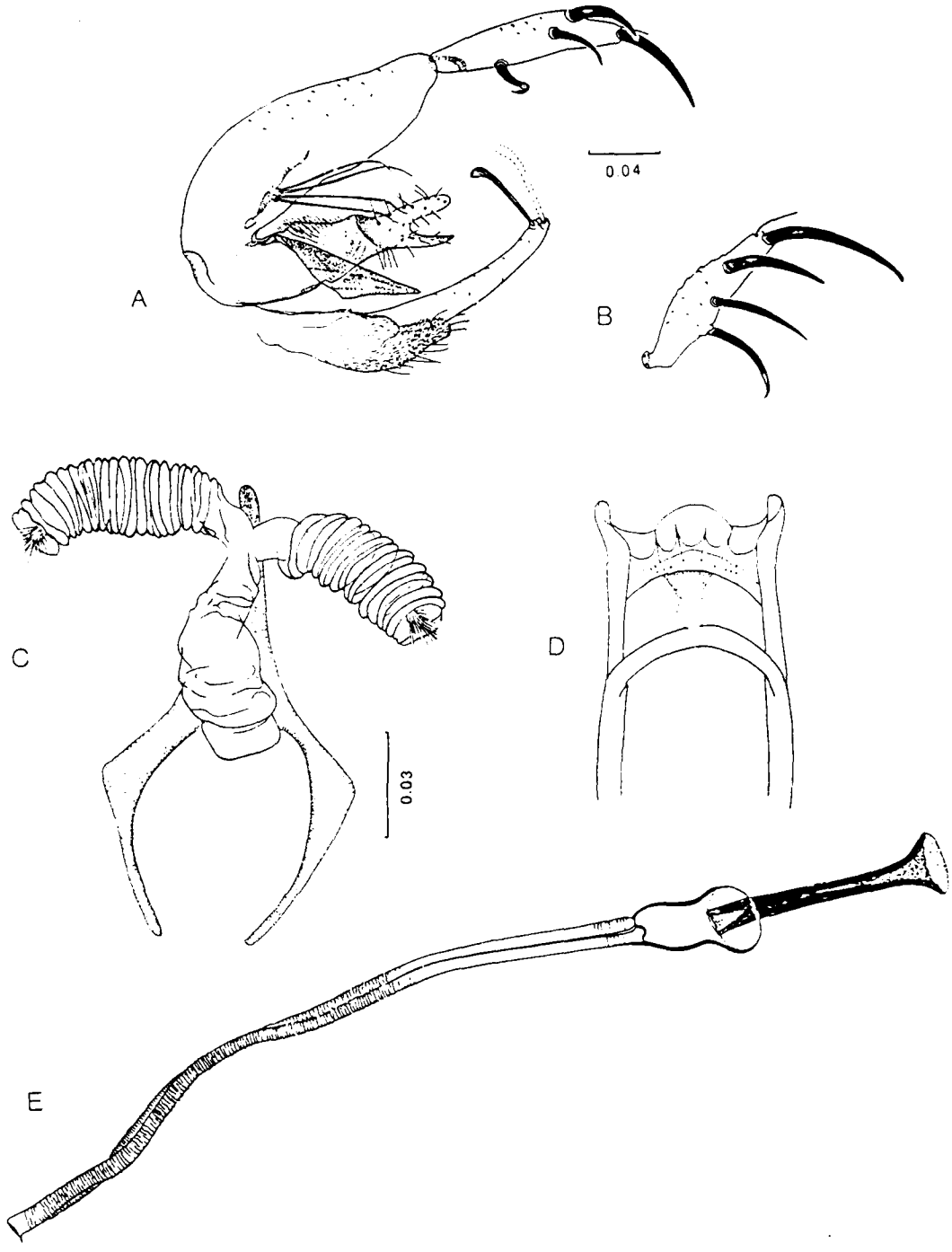



Plate 23-6

Lutzomyia brachyphalla. A. Male terminalia; B. Style; C. Spermathecae; D. Female cibarium; E. Genital pump & fliaments.

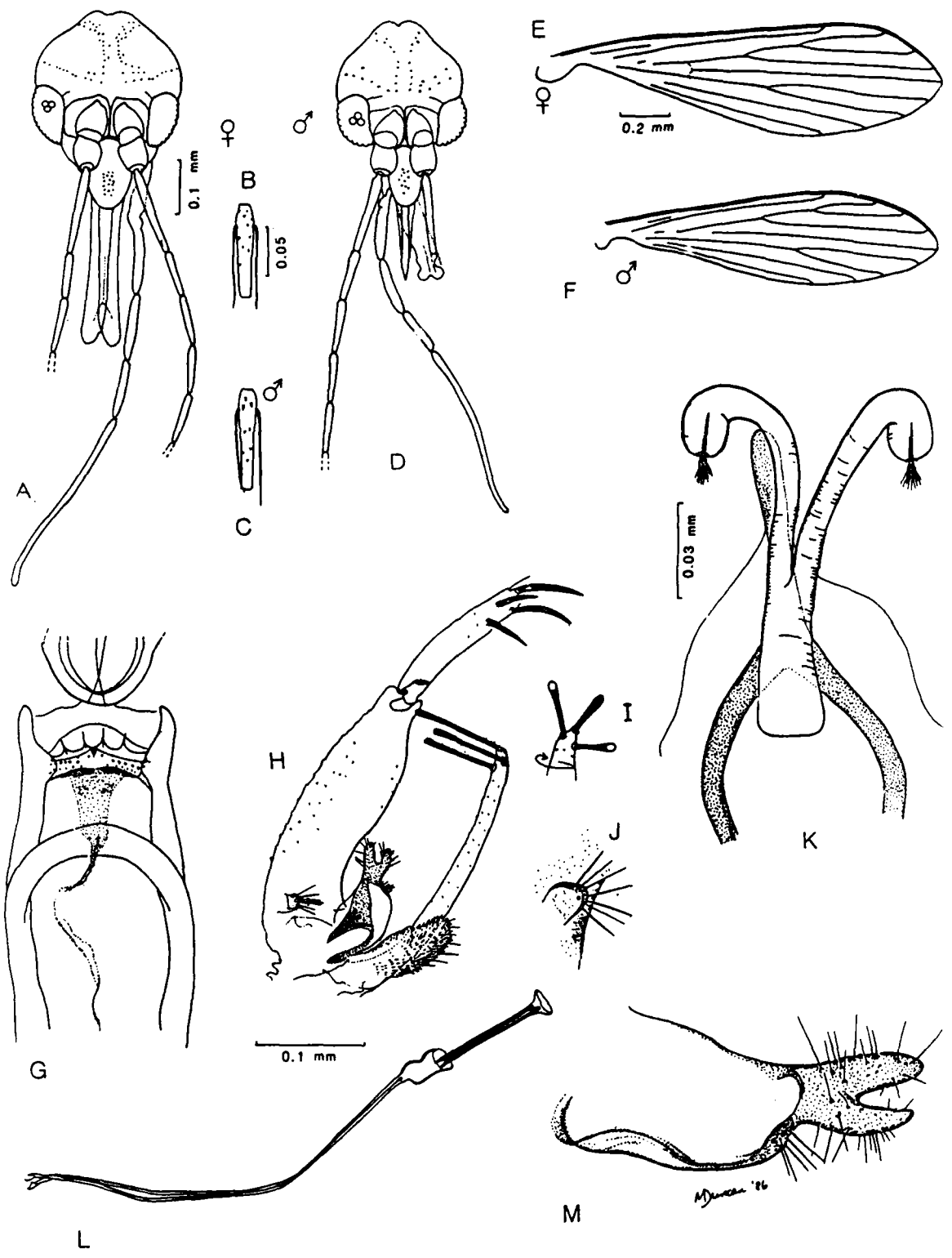



Plate 23-7

Lutzomyia cerqueirai. A. Female head; B. Female flagellomere II; C. Male flagellomere II; D. Male head; E. Female wing; F. Male wing; G. Female cibarium; H. Male terminalia; I. Tip of lateral lobe; J. Tubercle on coxite; K. Spermathecae; L. Genital pump & filaments; M. Paramere (from Young & Morales 1987).

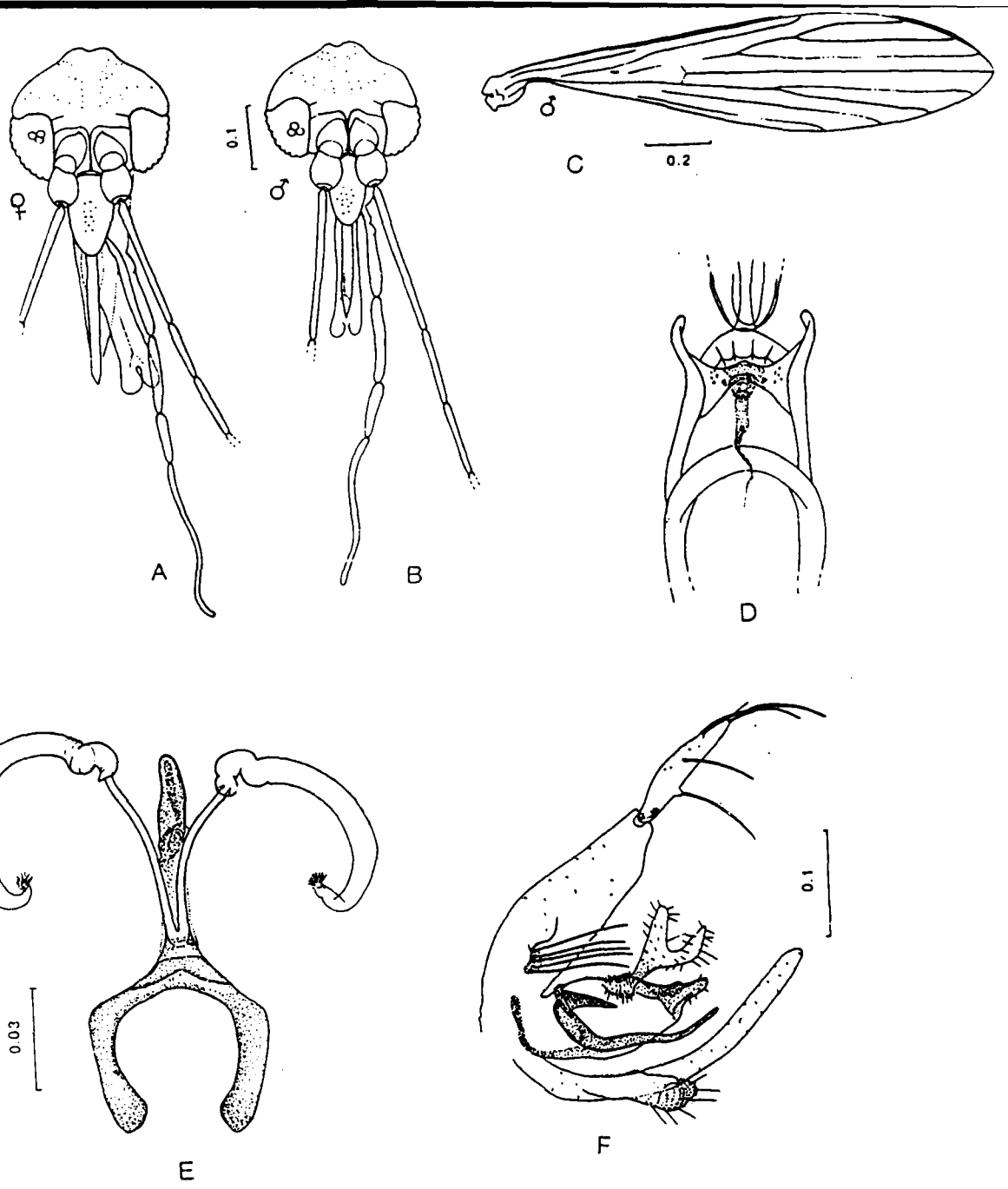



Plate 23-8

Lutzomyia monstruosa. A. Female head, B. Male head, C. Male wing, D. Female cibarium, E. Spermathecae, F. Male terminalia.

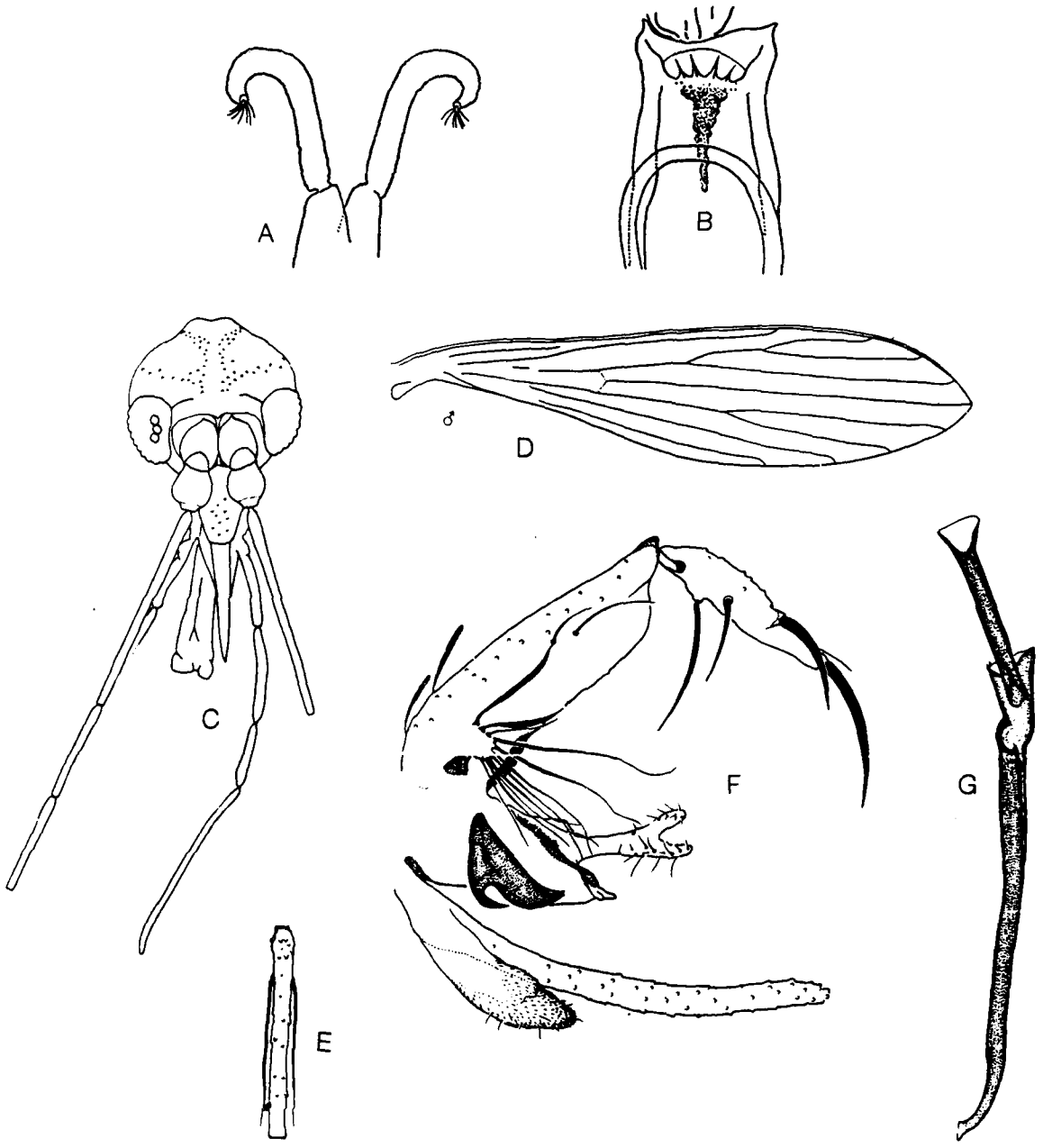


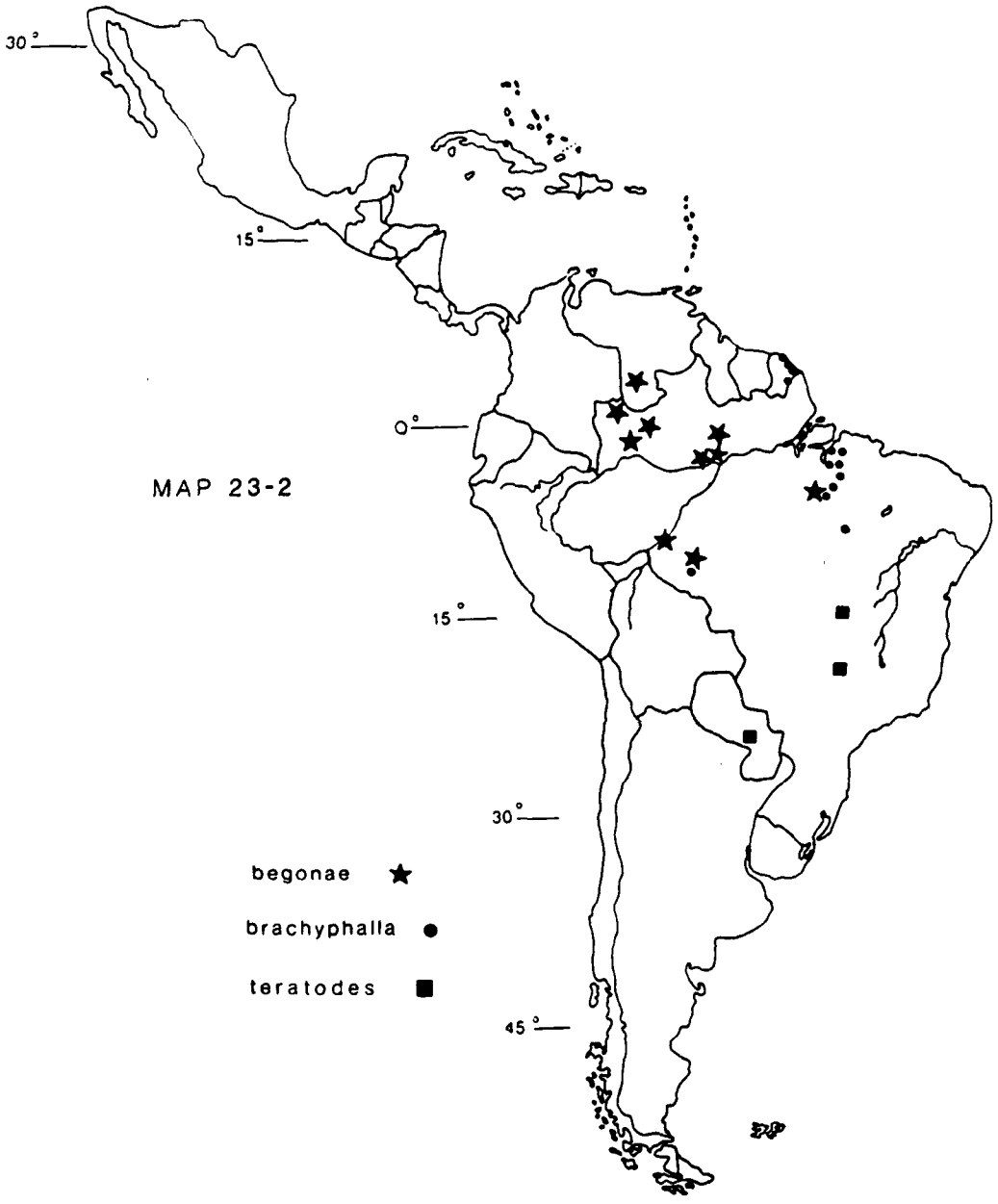

Plate 23-9

Lutzomyia teratodes. A. Spermathecae; B. Female cibarium; C. Male head; D. Male wing; E. Male flagellomere II; F. Male terminalia; G. Genital pump & filaments (figs. A & B from Martins et al. 1975d; figs. C-G from Young & Arias 1977).




MAP 23-1

infraspinosa ■




MAP 23-2


30°
15°
0°
15°
30°
45°
MAP 23-3
bourrouli
pinottii




MAP 23-4




MAP 23-5


30°
15°
0°
15°
30°
45°
MAP 23-6
monstrousa

## 24. Lutzomyia Subgenus Viannamyia Mangabeira

Lutzomyia subgenus Viannamyia Mangabeira 1941d: 251 (type species): (Phlebotomus tuberculatus Mang. by orig. designation). Barretto 1962: 94 (defined). Theodor 1965: 190 (defined). Forattini 1971a: 106; 1973: 506 (defined as genus of Phlebotominae).

Identification. Coloration dark. Antennal ascoids simple. Palpomere 5 relatively short, not larger than palps. 3 + 4. ♀ cibarium with 4 pointed horizontal teeth & complete arch. ♀ pharynx unarmed. Spermathecae associated with paired sclerotized processes. ♂ genitalia: Coxite lacking persistent setae at base but apical group present. Style deeply forked or else with median spine(s) inserted on distinct extension. Paramere with specialized setae, some having brush-like tips.

Medical Importance. Unknown. Females are not readily attracted to human bait. Leishmania braziliensis has been isolated from L. tuberculata in Brazil (see Ryan et al. 1987c).

### Key to the males of the subgenus Viannamyia

1. Style with two proximal spines implanted on separate arms or processes. Paramere as shown. ..... L. tuberculata (Pl. 24-3)
   Style with proximal spines implanted on a common arm. Paramere otherwise. ..... 2

2. Genital filament tips markedly enlarged. ..... L. fariasi (Pl. 24-2)

Genital filament tips slender & pointed. ..... 3

3. Paramere slender & downwardly curved distally. .....
..... L. furcata (Pl. 24-1)

Paramere slightly enlarged and stout distally, shaped like a goat's head. ..... L. caprina (Pl. 24-1)

Key to the females of the subgenus Viannamyia*

1. Spermathecae tubular, associated with larger funnel-shaped sclerotized processes. ..... L. tuberculata (Pl. 24-3)

Spermathecae oval, sclerotized processes rod-like. .....
..... L. caprina (Pl. 24-1)
L. furcata

*The female of L. fariasi remains unknown.

## Lutzomyia (Viannamyia) caprina Osorno, Morales & Osorno

Plate 24-1

Lutzomyia caprina Osorno, Morales & Osorno 1972a: 437 (♂, Vereda El Llano, Caldas, Colombia). Young 1979: 103 (full refs.). Morales & Minter 1981: 96 (questionable record, Colombia). Llanos 1981: 183 (listed, Peru). Murillo & Zeledon 1985: 47 (♂, ♀ figs., dist. Costa Rica).

Distribution (Map 24-1). Honduras (Young 1979); Costa Rica (Murillo & Zeledon 1985); Panama & Colombia (Young 1979); Peru (Llanos 1981).

Remarks. We have not detected structural differences between females of L. caprina and L. furcata; accordingly, the confirmation of either species in a given locality should be based on the presence of the male. From various sites in the Panama Canal Zone and Panama Prov., Panama, all males examined are assigned to L. caprina. One male from Honduras more closely resembles L. furcata and there is variation in paramere shape and setation among males from different populations (Young 1979).

## Lutzomyia (Viannamyia) furcata (Mangabeira)

Plate 24-1

Flebotomus furcatus Mangabeira 1941d: 256 (♂, Aurá, Belém, Pará, Brazil).

Phlebotomus arborealis Floch & Abonnenc 1944d: 8 (♀, Baduel, French Guiana). Young 1979: 104 (full refs.).

Lutzomyia arborealis: Barretto 1962: 94 (as synonym of furcata).

Lutzomyia furcata: Barretto 1962: 94. Theodor 1965: 190. Lainson et al. 1976b: 57 (Brazil). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 50 (refs., dist.). Arias & Freitas 1978: 391 (negative for flagellate infections, Brazil). Young 1979: 104 (figs., refs.). Fraiha et al. 1980a: 21 (Peru). Morales & Minter 1981: 96 (questionable record, Colombia). Llanos 1981: 183 (Peru). Shaw 1981: 232 (exper. infections with Endotrypanum). Lewis & Mcfarlane 1981: 181 (mite parasite, Columbia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Ready et al. 1984b: 641 (age grading ♀♀). Murillo & Zeledon 1985: 47 (dist. Costa Rica, fig.). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (negative for flagellate infections Brazil). Ready et al. 1986: 34 (Pará, Brazil). Ryan 1986: 119 (figs., dist., Brazil). Ryan et al. 1987a: 356 (negative for flagellate infections, Brazil). Lebbe et al. 1987: 30 (computer aided ident.).

Viannamyia furcata: Forattini 1971a: 106; 1973: 507 (figs.).

Distribution (Map 24-2). Costa Rica (Murillo & Zeledon 1985); Colombia; Venezuela; French Guiana; Brazil and Peru (see refs. listed above).

Remarks. The record of L. furcata from Iquitos District, Peru (Fraiha et al. 1980a) was based on a female but the male is needed to confirm its presence there.

Hanson (1968) described the first and fourth larval stages and pupa from immatures reared in Panama. The possibility exists that they represented L. caprina, not L. furcata.

## Lutzomyia (Viannamyia) fariasi (Damasceno, Causey & Arouck)

Plate 24-2

Flebotomus fariasi Damasceno, Causey & Arouck 1945: 19 (♂, Santarem, Pará, Brazil).

Phlebotomus farasi: Fauran 1960: 8 (♂, French Guiana).

Lutzomyia fariasi: Barretto 1962: 94 (listed). Theodor 1965: 190 (listed). Leger et al. 1977: 226 (French Guiana). Martins et al. 1978: 50 (dist., refs.). Ryan 1986: 115 (fig.). Lebbe et al. 1987: 30 (computer aided ident.).

Viannamyia fariasi: Forattini 1971a: 106; 1973: 507 (figs.).

Distribution (Map 24-1). Brazil; French Guiana (Martins et al. 1978).

Remarks. This species remains known only from the male and is rarely collected. The holotype (Pl. 24-2) has slightly modified setae of the parameres, similar to, but less developed, than dorsal setae observed in other Lutzomyia (Viannamyia) spp. males.

## Lutzomyia (Viannamyia) tuberculata (Mangabeira)

Plate 24-3

Flebotomus tuberculatus Mangabeira 1941d: 251 (♂, Aurá, Belém, Pará, Brazil).

Phlebotomus sp. x Floch & Abonnenc 1944a: 10 (♀, French Guiana. Barretto 1962: 94 (as ♀ of tuberculata).

Lutzomyia munangai Wijers & Huisenga 1967: 395 (♂, Suriname). Lewis 1975a: 511( as synonym of tuberculata).

Lutzomyia tuberculata: Leger et al. 1977: 218 (French Guiana. Martins et al. 1978: 52 (figs., refs., dist.). Arias & Frietas 1978: 391 (negative for flagellates, Brazil). Young 1979: 106 (figs., refs., dist.). Morales & Minter 1981: 96 (Colombia). Arias & Freitas 1982: 405 (Acre, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias et al 1985: 1101 (negative for flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 29 (N. Brazil). Ryan 1986: 117 (figs., dist.). Ryan et al. 1987a: 356 (negative for flagellates). Lebbe et al. 1987: 30 (computer aided ident.).

Viannamyia tuberculata: Forattini 1971a: 106; 193: 510 (figs.).

Distribution (Map 24-3). Panama (Young 1979); Colombia (Martins et al 1978; Young 1979; Morales & Minter 1981); French Guiana; Suriname (Martins et al. 1978); Brazil (Martins et al. 1978; Arias & Freitas 1982; Biancardi et al. 1982; Ryan 1986).

Remarks. Lutzomyia tuberculata likely occurs in other parts of Amazonia that have not been adequately sampled (e.g., Venezuela, Ecuador and Bolivia.)

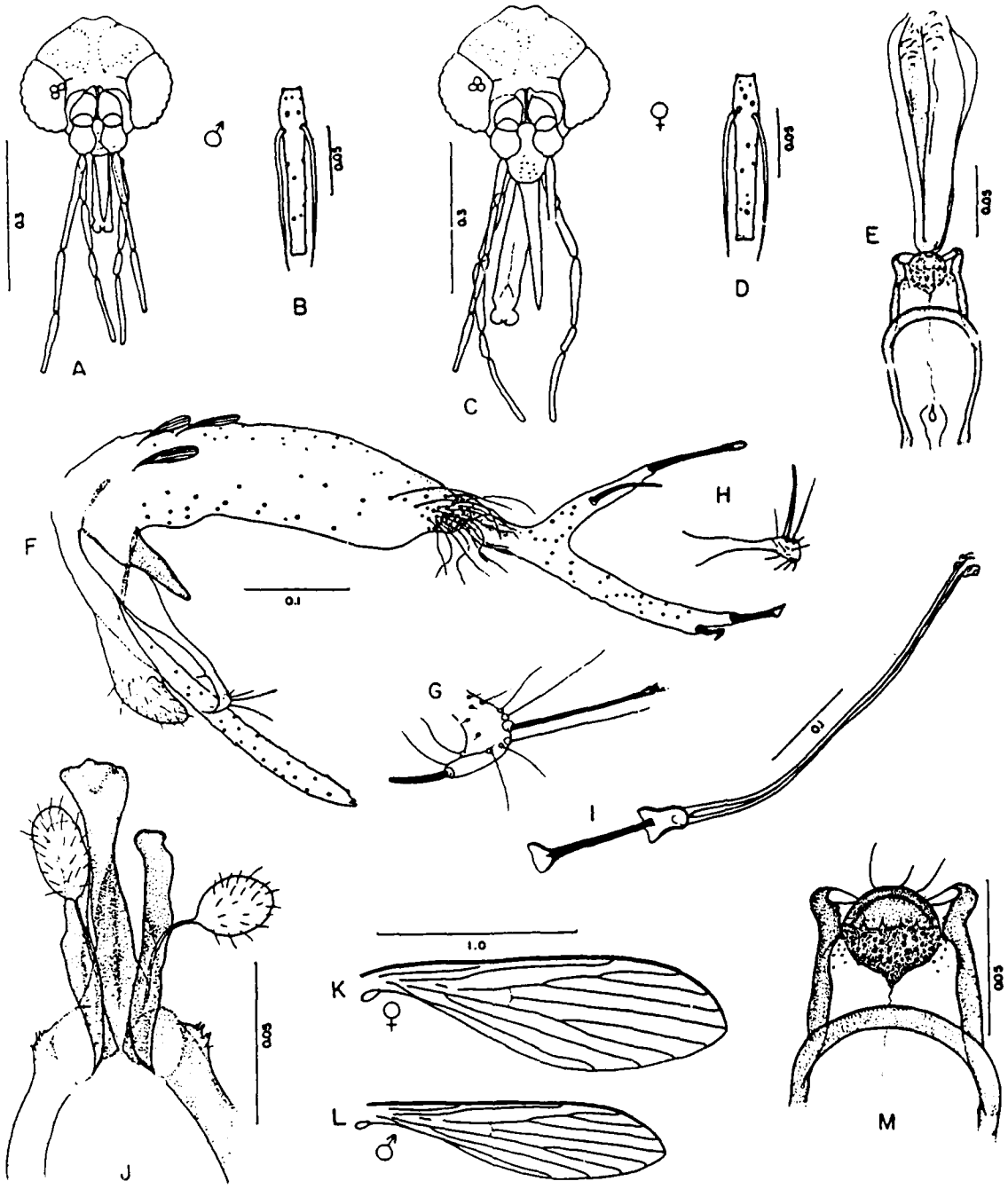



Plate 24-1

Lutzomyia caprina. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; H. Tip of paramere of male from Rio Anori, Antioquia Dept., Colombia; I. Genital pump & filaments, J. Spermathecae, K. Female wing, L. Male wing, M. Female cibarium.

Lutzomyia furcata. G. Apex of paramere. (from Young 1979)

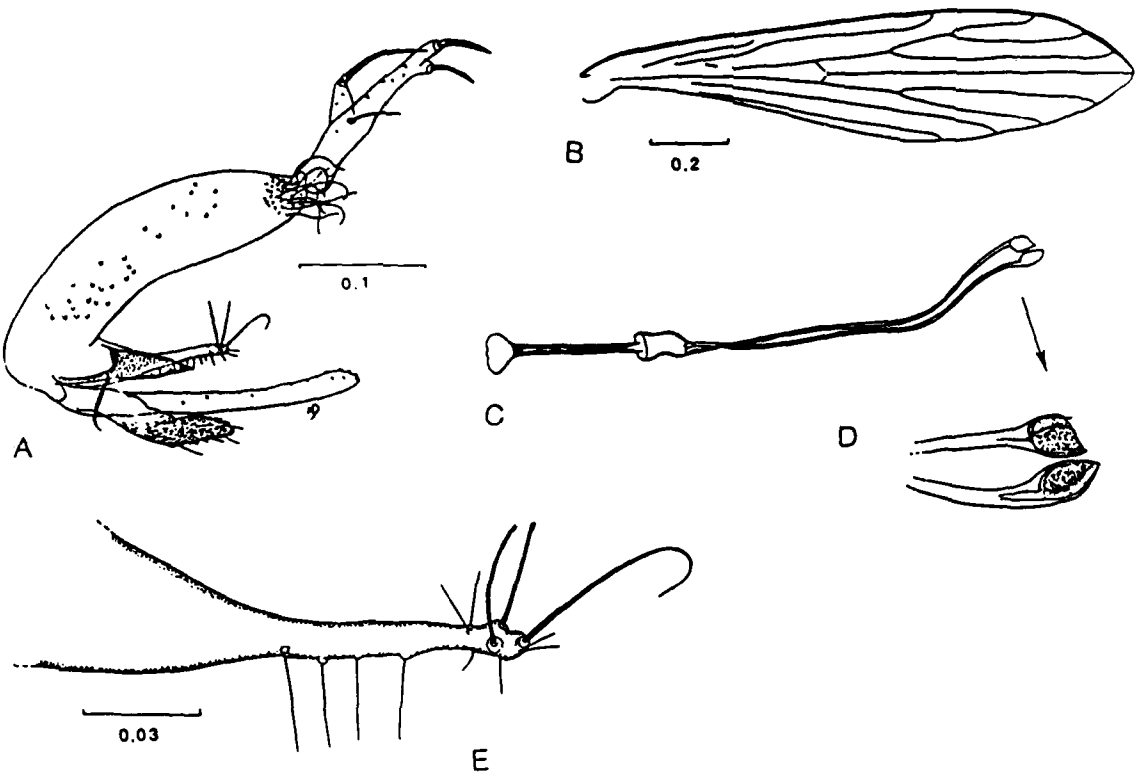



Plate 24-2

Lutzomyia fariasi. A. Male terminalia, B. Male wing, C. Genital pump & filaments, D. Tips of genital filaments, E. Paramere.

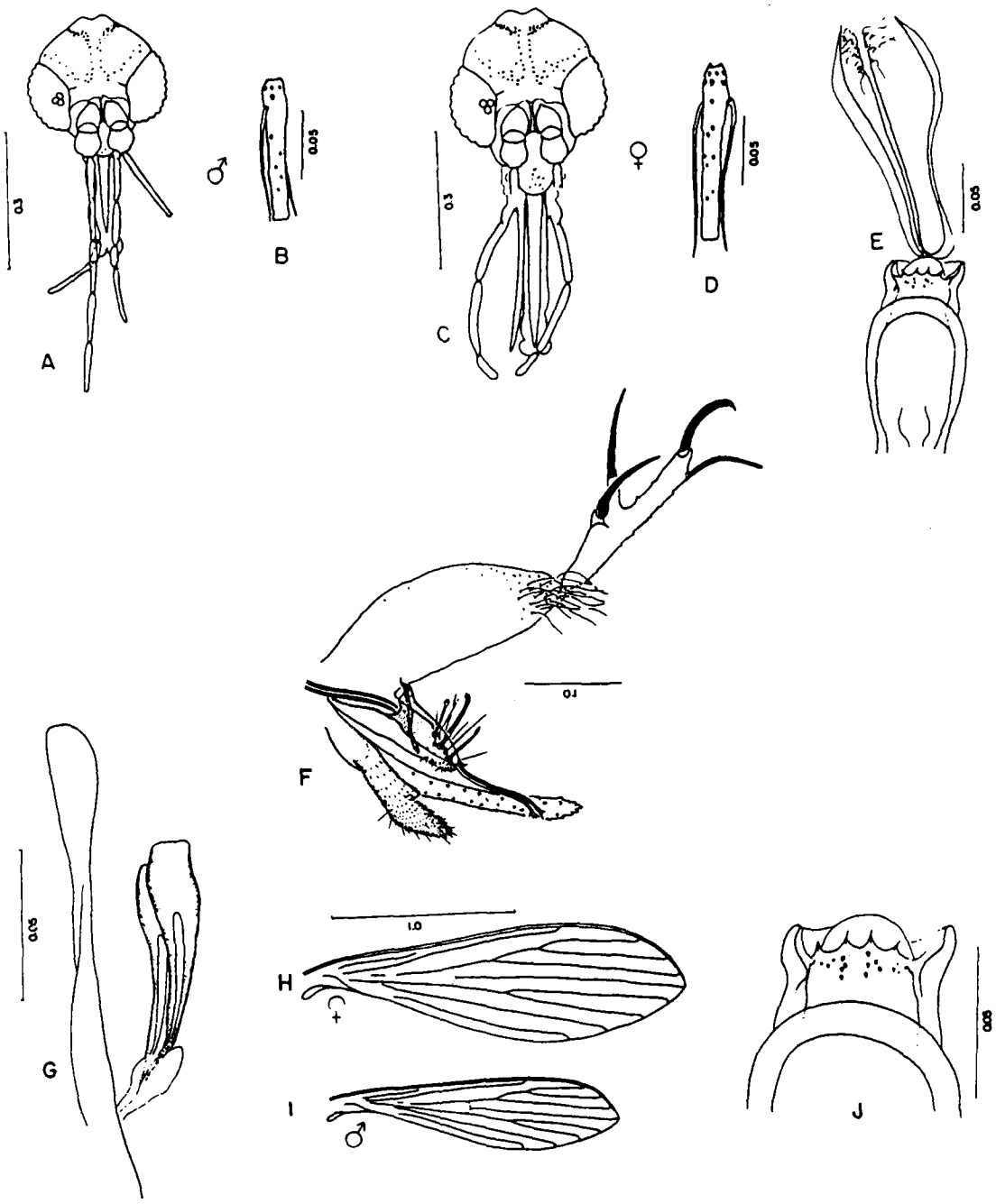



Plate 24-3

Lutzomyia tuberculata. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; G. Spermathecae; H. Female wing; I. Male wing; J. Female cibarium (from Young 1979).


30°
15°
0°
15°
30°
45°
MAP 24-1
fariasi
caprina




MAP 24-2




MAP 24-3

## 25. Lutzomyia Species Group Rupicola

Lutzomyia species group rupicola Lewis et al. 1977.

Identification. Coloration light brown. Antennal ascoids simple. Palpomere 5 longer than palp. 3 + 4. ♀ cibarium with 4 small horizontal teeth; arch nearly complete. ♀ pharynx unarmed. Spermathecae globose; common duct much longer than individual ducts. ♂ genitalia. Coxite with 3 long modified setae inserted on common tubercle. Style with 4 spines, median pair inserted on long process, basal spine isolated & much smaller than others; subterminal seta absent. Paramere backwardly turned at apex.

Of the 2 species included in this group, only the female of L. correalimai is known with certainty. It resembles some of the migonei group females in the structure of the spermathecae & cibarial armature but the male lacks a subterminal seta on the style and the median spines are borne on a long process, unlike those in the migonei group. Martins et al. (1978) include these 2 species with aberrant and ungrouped species.

### Key to the males of the Species Group Rupicola

1. Style with basal spine reduced to a fine, thin seta. Antennal ascoids reaching ends of their respective flagellomeres. ..... L. rupicola (Pl. 25-1)

Style with larger basal spine. Antennal ascoids not reaching to end of their respective flagellomeres. ..... L. correalimai (Pl. 25-1)

Lutzomyia rupicola Martins, Godoy & Silva

Plate 25-1

Lutzomyia rupicola Martins, Godoy & Silva 1962c: 57 (♂, Petrópolis, Rio de Janeiro, Brazil.) Martins, Coutinho & Luz 1970c: 189 (cf. to correalimai). Forattini 1973: 288 (♂ fig.). Martins et al. 1978: 167 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Aguiar et al. 1985c: 467 (coll. data, Brazil).

Distribution (Map 25-1). Brazil (Martins et al. 1978; Mayrink et al. 1979; Aguiar et al. 1985c).

Remarks. Martins et al. (1978) suggested that L. rupicola may be a geographic variant of L. correalimai but that its status can be determined only when the female becomes known. Mayrink et al. (1979) provisionally identified female sand flies from Minas Gerais State, Brazil as L. rupicola but we have not examined specimens or seen descriptions from these collections.

## Lutzomyia correalimai Martins, Coutinho & Luz

Plate 25-1

Lutzomyia correalimai Martins, Coutinho & Luz 1970c: 189 (♂, ♀, Curitiba, Parana, Brazil). Forattini 1973: 283 (♂, ♀ figs., tax.). Martins et al. 1978: 163 (refs., dist.).

Distribution (Map 25-1). Brazil (Martins et al. 1978).

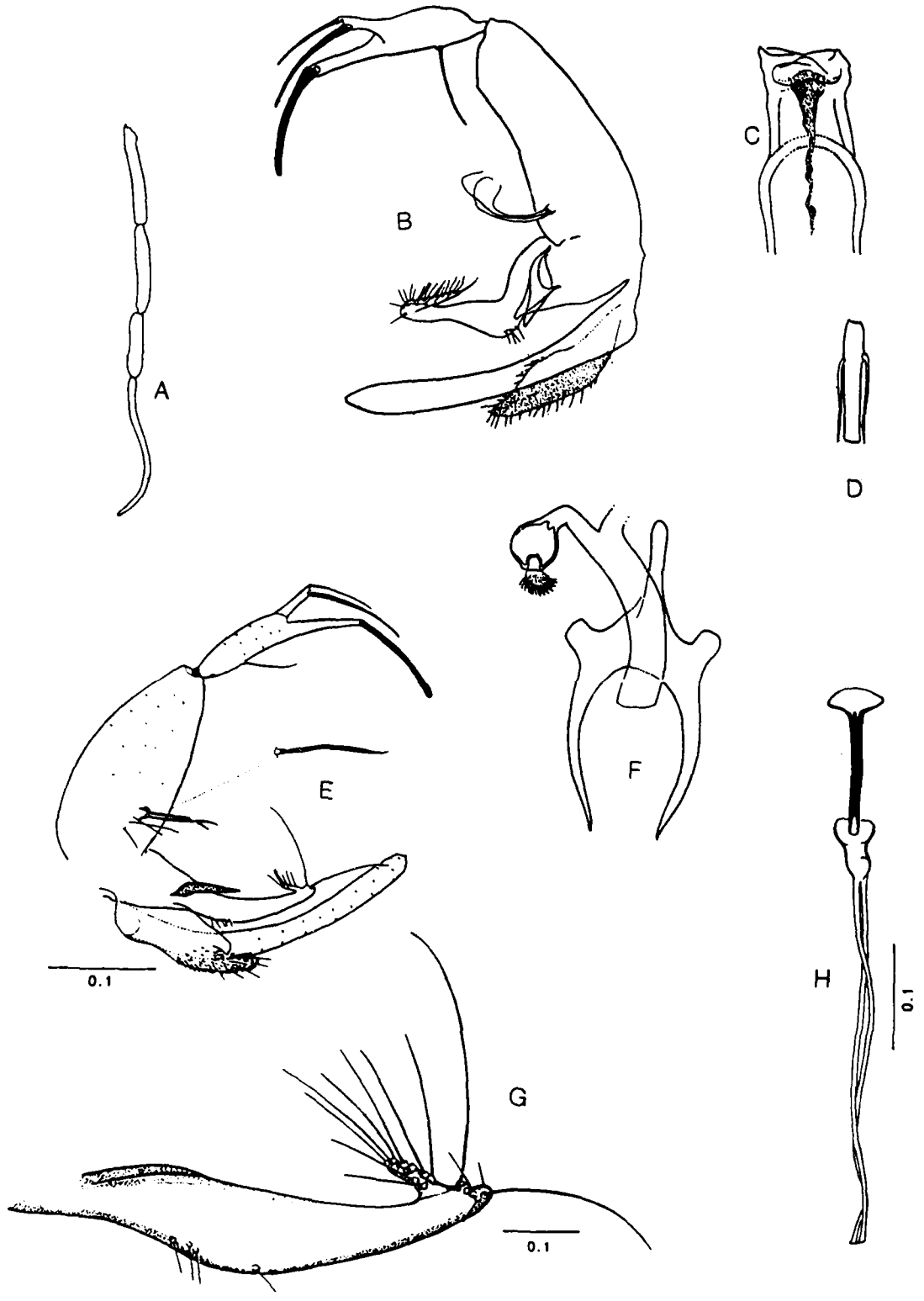



Plate 25-1

Lutzomyia correalimai. A. Male palpus; B. Male terminalia; C. Female cibarium; D. Female flagellomere II; F. Spermatheca other not shown (all figs. from Martins et al. 1970).

Lutzomyia rupicola. E. Male terminalia; G. Paramere; H. Genital pump & filaments.




MAP 25-1

## 26. Lutzomyia Subgenus Psathyromyia Barretto

Lutzomyia subgenus Psathyromyia Barretto 1962: 98 (type species: Phlebotomus shannoni by orig. designation). Martins et al. 1978: 104 (in part, defined).

Lutzomyia species group shannoni: Theodor 1965: 189. Lewis et al. 1977: 328.

Lutzomyia subgenus Trichopygomyia (in part): Forattini 1971a: 102; 1973: 294.

Lutzomyia species group brasiliensis (in part) Martins et al. 1978.

Lutzomyia subgenus Forattiniella (in part) Vargas 1978:89 (type species: Phlebotomus lutziana Costa Lima by orig. designation).

Identification. Coloration variable, no completely pale species known. Antennal ascoids with short to long proximal spurs. Palpomere 5 variable, usually shorter than palps. 2 + 3 + 4. ♀ cibarium with 4-8 horizontal teeth; a complete arch & prominent pigment patch; vertical teeth present. Pharynx unarmed. Spermathecae smooth walled capsules or spher.cal structures or cylindrical with annulations. ♂ genitalia. Coxite lacking persistent setae. Style with 4 spines & no subterminal seta. Paramere simple or with dorsal setiferous arm. Lateral lobe without specialized setae.

The species in this subgenus appear to be closely related to those in the aragaoi species group and Barretto (1962) includes them in

Psathyromyia. Martins et al. (1978) separate L. campbelli and L. dasymera from the others included here, placing them in the dreisbachi species group. Forattini (1971a; 1973) includes most of these species in the Lutzomyia subgenus Trichopygomyia.

Medical Importance. Unknown; L. abonnenci has served as a laboratory host for Leishmania mexicana; there are several man-biting records for L. shannoni, a species considered by Zeledón & Alfaro (1973) to be a probable vector of Leishmania in Costa Rica. Lutzomyia dendrophyla has also been found naturally infected with flagellates in Brazil and females have been taken on human bait (Lainson & Shaw 1979; Ryan et al. 1987a). Other information is given in the individual species accounts.

Key to the Males of the Subgenus Psathyromyia

1. Paramere with a dorsal setiferous arm. ..... 2
   Paramere simple, without a dorsal arm. ..... 3

2. Genital filament tips with several small teeth. .....
   ..... L. campbelli (Pl. 26-2)
   Genital filament tips without teeth. ..... L. dasymera (Pl. 26-1)

3. Genital filaments about 1.5X length of pump, their tips inflated. Aedeagus wider apically than at middle. ..... L. lutziana (Pl. 26-3)
   Genital filaments at least 2X length of pump, their tips inflated or not. Aedeagus wider at middle than at end. ..... 4

4. Antennal ascoids with short proximal spurs (Pl. 26-4). ..... 5

Antennal ascoids with long proximal spurs (Pl. 26-8). ..... 6

5. Style with isolated basal spine. Paramere as shown. Antennal ascoids with proximal spurs having pointed tips. .....

..... L. guatemalensis (Pl. 26-4)

Style with basal spines paired, inserted at same level. Paramere otherwise. Antennal ascoids with proximal spurs having blunt rounded tips. ..... L. punctigeniculata (Pl. 26-5)

6. Paramere with a ventral row of enlarged setae extending to end of paramere. ..... L. cratifer (Pl. 26-6)

Paramere otherwise, without such setae. ..... 7

7. Paramere with sinuous dorsal setae. ..... 8

Paramere without such setae. ..... 9

8. Paramere with a subterminal ventral heel. ..... L. soccula (Pl. 26-7)

Paramere without such a process. ..... L. undulata (Pl. 26-6)

9. Paramere with dorsal setae restricted to apical third of structure.

..... L. abonnenci (Pl. 26-8)

Paramere with dorsal setae covering distal half or more of structure. ..... 10

10. Style with proximal spine inserted beyond middle of segment.

..... L. cuzquena (Pl. 26-9)

Style with proximal spine inserted at middle of segment. ..... 11

11. Paramere as shown, distal slender part abruptly joining the wider basal section. Genital filament tips modified, filaments longer than 3X pump length. ..... L. souzacastroi (Pl. 26-10)

Paramere otherwise, more slender throughout. Genital filament tips simple, filaments shorter than 3X pump length. ..... 14

12. Pleuron and scutum equally well pigmented. Paramere as shown. ..... L. scaffi (Fig. 26-11)

Pleuron much paler than scutum. ..... 13

13. Paramere with terminal dorsal setae almost foliaceous, i.e., with thickened, slightly bent ends. ..... 14

Paramere with simple dorsal setae. ..... 15

14. Paramere with median group of 30+ short setae. ..... ..... L. dendrophyla (Pl. 26-12)

Paramere without well defined group of short setae. ..... ..... L. pestanai (Pl. 26-13)

15. Paramere width subequal to or greater than width of lateral lobe, ventral apical setae long & directed backwards. ..... ..... L. volcanensis (Pl. 26-14)

Paramere more slender, its width less than lateral lobe width, without long ventral setae at apex. ..... L. shannoni (Pl. 26-15)

## Key to the Females of the Subgenus Psathyromyia*

1. Spermathecae cylindrical, longer than wide, annulated or not. ..... 2

   Spermathecae spherical, about as long as wide. .. L. lutziana (Pl. 26-3)

2. Cibarium with 6 or more horizontal teeth. ..... 3

   Cibarium with 4 horizontal teeth. ..... 5

3. Spermathecae with complete or nearly complete annulations.

   ..... L. undulata (Pl. 26-6)

   L. cratifer

   Spermathecae without annulations. ..... 4

4. Antennal ascoids with short blunt proximal spurs. Individual sperm ducts shorter than 2X length of spermatheca. .....

   ..... L. punctigeniculata (Pl. 26-5)

   Antennal ascoids with long pointed proximal spurs. Individual sperm ducts longer that 2.5X length of spermatheca. ... L. dasymera (Pl. 26-1)

   L. campbelli (Pl. 26-2)

5. Spermathecae with complete or nearly complete annulations. ..... 6

   Spermathecae without annulations, smooth walled. ..... 7

---

*The females of L. cuzquena, L. soccula and L. souzacastroi are unknown. It is likely, however, that they resemble L. shannoni in details of the cibarial armature and spermathecae.

6. Antennal ascoids with long proximal spurs extending to end, or nearly to end, of preceding flagellomere. ... L. volcanensis (Pl. 26-14)

Antennal ascoids with very short, barely discernible, proximal spurs. ..... L. guatemalensis (Pl. 26-4)

7. Pleuron with areas of dark pigmentation. ..... 9

Pleuron pale; contrasting to dark scutum. ..... L. shannoni (Pl. 26-15)

L. abonnenci (Pl. 26-8)

L. pestanai (Pl. 26-13)

8. Pleuron darkly pigmented throughout. ..... L. scaffi (Pl. 26-11)

Pleuron darkly pigmented except for metathoracic area. ..... L. dendrophyla (Pl. 26-12)

## Lutzomyia (Psathyromyia) dasymera (Fairchild & Hertig)

Plate 26-1

Phlebotomus dasymerus Fairchild & Hertig 1961b: 242 (♂, ♀, Panama Canal Area (Zone).

Lutzomyia dasymera: Barretto 1962: 99. Theodor 1965: 193 (listed). Martins et al. 1978: 154 (refs., dist.). Young 1979: 111 (♂, ♀ figs., full refs.). Feliciangeli 1980: 246 (Venezuela). Biancardi et al. 1982: 168 (Rondonia, Brazil). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 87 (figs., Costa Rica).

Distribution (Map 26-1). Mexico; Belize; Nicaragua; Panama; Colombia; Venezuela (Martins et al. 1978; Young 1979); Costa Rica (Murillo & Zeledón 1985); Brazil (Biancardi et al. 1982).

Remarks. See L. campbelli.

Lutzomyia (Psathyromyia) campbelli (Damasceno, Causey & Arouck)

Plate 26-2

Flebotomus campbelli Damasceno, Causey & Arouck 1945: 26 (♂, Machira, Pará, Brazil). Barretto 1947a: 191 (listed).

Phlebotomus campbelli: Fauran 1971: 5 (♂, French Guiana).

Lutzomyia campbelli: Theodor 1965: 194 (listed). Llanos 1973: 33 (figs., Peru). Forattini 1973: 303 (figs., tax.);. Llanos et al. 1975a: 655 (♀, Peru); 1975b: 669 (Peru). Leger et al. 1977: 227 (French Guiana). Llanos et al. 1978: 153 (dist.). Martins et al. 1978: 153 (refs., dist.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Young et al. 1985: 143 (Peru). Ryan 1986: 90 (♂ ♀ figs., Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 26-2). French Guiana (Leger et al. 1977; Martins et al. 1978); Brazil (Martins et al. 1978); Biancardi et al. 1982; Arias &

Freitas 1982; Ryan 1986); Peru (Llanos et al. 1975a; Martins et al. 1978); Bolivia (Martins et al. 1978; Le Pont & Desjeux 1986).

Remarks. The male of L. campbelli has a row of short teeth on the tip of each genital filament (absent in L. dasymera). There are no other structural differences between the males and the females are morphologically indistinguishable.

Lutzomyia (Psathyromyia) lutziana (Costa Lima)

Plate 26-3

Phlebotomus lutzianus Costa Lima 1932: 48 (♂, Lassance, Minas Gerais, Brazil).

Phlebotomus sp. of Cayenne Floch & Abonnenc 1945b: 3 (♀, French Guiana). Leger et al. 1977: 229 (French Guiana).

Flebotomus lutzianus: Barretto 1947a: 209 (full refs.).

Lutzomyia lutziana: Theodor 1965: 189 (listed). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 145 (refs., dist., in species group braziliensis). Feliciangeli 1980: 240 (Venezuela). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young et al. 1985: 143 (Peru). Ryan 1986: 92 (♂, ♀ figs., Brazil). Young & Morales 1987: 662 (Amazonas, Colombia). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 26-1). Venezuela (Martins et al. 1978); French Guiana (Leger et al. 1977; Martins et al. 1978); Colombia (Young & Morales 1987); Peru (Young et al. 1985); Brazil (Lainson et al. 1976; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Paraguay (1 ♂, Acá-Poi, San Pedro, Shannon trap, May 1950, M. Hertig). Suriname (2 ♀♀, Patamakka, 1983-84, A.M. Burgos).

Remarks. This rather pale species was provisionally identified from collections made near Caratinga, Minas Gerais, Brazil by Mayrink et al. (1979).

The placement of L. lutziana in the subgenus Psathyromyia, as defined in the present review, is also considered provisional. The spherical spermathecae are unlike those of other species in this subgenus but on the basis of other character states (e.g., long proximal spurs of the antennal ascoids), both sexes appear to be more closely related to the Psathyromyia spp. than to other species.

Lutzomyia lutziana has not been previously reported in Paraguay or in Suriname.

## Lutzomyia (Psathyromyia) guatemalensis Porter & Young

Plate 26-4

Lutzomyia guatemalensis Porter & Young 1986: 236 (♂, ♀, Montana Plan de Pinto, Chiquimula, Guatemala).

Distribution (Map 26-3). Guatemala (Porter & Young 1986).

## Lutzomyia (Psathyromyia) punctigeniculata (Floch & Abonnenc)

Plate 26-5

Phlebotomus punctigeniculatus Floch & Abonnenc 1944b: 5 (♂, ♀, French Guiana).

Phlebotomus christophersoni Damasceno & Causey 1944: 347 (♂, Santarem, Pará, Brazil). Fairchild & Hertig 1950: 526 (as synonym of punctigeniculata).

Lutzomyia punctigeniculata: Barretto 1962: 99 (listed). Llanos 1973: 33 (figs., Peru). Llanos et al. 1975b: 671 (Peru). Arias & Freitas 1977: 511 (Amazonas, Brazil); 1978: 391 (negative for flagellates, Brazil). Martins et al. 1978: 108 (refs, dist.). Ramirez Perez 1978: 52 (♂, ♀ figs., Venezuela). Young 1979: 115 (♂, ♀ figs., refs.). Fraiha et al. 1980a: 21 (Peru). Ramirez Perez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela). Arias & Freitas 1982a: 404 (Acre, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Porter & Young 1986: 239 (cf. to guatemalensis). Ready et al. 1986: 35 (as potential vector of leishmaniasis). Ryan 1986: 93 (♂, ♀ figs., Pará Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela).

Distribution (Map 26-4). Panama; French Guiana; Peru; Colombia (Martins et al. 1978; Young 1979); Brazil (Martins et al. 1978; Arias & Freitas

1982; Ryan 1986); Bolivia (Martins et al. 1978); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978; 1981; 1982a; 1982b; Feliciangeli 1987a; 1987b); Suriname (2 ♂♂, Patamakka, 19 May 1985, A.M. Burgos).

Remarks. Ready et al. (1986) collected in the forest canopy in Pará State, Brazil and speculated that females could be involved in transmitting Leishmania guyanensis among arboreal mammal hosts.

## Lutzomyia (Psathyromyia) cratifer (Fairchild & Hertig)

Plate 26-6

Phlebotomus cratifer Fairchild & Hertig 1961b: 242 (♂, ♀, Palenque, Chiapas, Mexico).

Lutzomyia cratifer (or cratifera): Theodor 1965: 194 (listed). Forattini 1973: 303 (♂ fig., tax.). Martins et al. 1978: 107 (refs., dist.). Young 1979: 119 (mention). Murillo & Zeledón 1985: 87 (figs., Costa Rica). Porter & Young 1986: 239 (cf. to guatemalensis).

Distribution (Map 26-2). Mexico; Belize; Honduras; Panama (Fairchild & Hertig 1961b); Costa Rica (Murillo & Zeledón 1985).

Remarks. The published records of L. cratifer in Colombia and Panama (Osorno et al. 1972a; Martins et al. 1978) refer instead to L. undulata, a species having a wider geographic distribution.

Lutzomyia (Psathyromyia) soccula (Fairchild & Hertig)

Plate 26-7

Phlebotomus socculus Fairchild & Hertig 1961b: 240 (♂, Almirante, Bocas del Toro, Panama).

Lutzomyia soccula: Theodor 1965: 189 (listed). Forattini 1973: 329 (♂ fig., tax.). Martins et al. 1978: 111 (listed as socculus). Christensen et al. 1983: 466 (Panama). Murillo & Zeledón 1985: 94 (♂ fig., Costa Rica).

Distribution (Map 26-5). Costa Rica (Murillo & Zeledón 1985); Panama (Fairchild & Hertig 1961b).

Lutzomyia (Psathyromyia) undulata (Fairchild & Hertig)

Plate 26-6

Phlebotomus undulatus Fairchild & Hertig 1950b: 524 (♂, Guatemala); 1961b: 244 (cf. to cratifer). Rosabal & Trejos 1964: 169 (♂ figs., El Salvador); 1965: 222 (El Salvador).

Phlebotomus humboldti Vargas & Najera 1959: 143 (♂, ♀, Oaxaca, Mexico). Rosabal & Trejos 1964: 169 (as synonym of undulatus).

Lutzomyia undulata: Barretto 1962: 99 (listed). Forattini 1973: 323 (♂, ♀, tax.). Martins et al. 1978: 111 (refs., dist.). Young 1979: 119 (♂, ♀ figs., refs.). Young & Rogers 1984: 599 (listed, Ecuador). Murillo &

Zeledón 1985: 94 (♂, ♀ figs., Costa Rica). Porter & Young 1986: 239 (Guatemala).

Distribution (Map 26-6). Mexico; Guatemala; Belize; Honduras; El Salvador; Costa Rica; Panama; Colombia; Ecuador (Martins et al. 1978; Young 1979; Murillo & Zeledón 1985); Guatemala (Porter & Young 1986).

Remarks. The females of L. undulata and L. cratifer are structurally indistinguishable and males must be available to confirm the presence of the species in given localities.

## Lutzomyia (Psathyromyia) abonnenci (Floch & Chassignet)

Plate 26-8

Phlebotomus abonnenci Floch & Chassignet 1947c: 1 (♂, Baduel, French Guiana).

Lutzomyia abonnenci: Barretto 1962: 99 (listed). Leger et al. 1977: 223 (French Guiana). Martins et al. 1978: 106 (refs., dist.). Young 1979: 109 (♂ figs., refs.). Morales & Minter 1981: 96 (Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Morales et al. 1982: 19 (tax., figs.). Christensen et al. 1983: 467 (coll. data, Panama). Young et al. 1985: 143 (Peru). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 36 (Pará, Brazil). Ryan 1986: 89 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Walters et al 1987: 294 (as exper. host of Leishmania mexicana).

Distribution (Map 26-3). Panama (Martins et al. 1978); Colombia (Young 1979; Morales & Minter 1981); French Guiana (Leger et al. 1977; Martins et al. 1978; Geoffroy et al. 1986); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986). Peru (Martins et al. 1978; Llanos 1981; Young et al. 1985).

Remarks. The female of L. abonnenci, illustrated in this review from a laboratory reared specimen, is structurally similar to L. shannoni and L. dendrophyla. Morales et al. (1982) provided a key to these and other closely related species but some of the character states (e.g., length of common ducts) appear to be variable.

Lutzomyia (Psathyromyia) cuzquena Martins, Llanos and Silva

Plate 26-9

Lutzomyia cuzquena Martins, Llanos & Silva 1975e: 650 (♂, Pilcopata, Cuzco, Peru). Llanos et al. 1975b: 670 (Peru). Llanos 1981: 183 (Peru) Young & Morales 1987: 662 (♂, Amazonas, Brazil).

Distribution (Map 26-3). Colombia (Young & Morales 1987); Peru (Llanos et al.

1975b).

Remarks. The male L. cuzquena can be confused with that of L. souzacastroi but the filament tips are simple; the subterminal spine on the style is relatively close to the subterminal spine and the paramere is different in shape.

Lutzomyia (Psathyromyia) souzacastroi (Damasceno & Causey)

Plate 26-10

Flebotomus souzacastroi Damasceno & Causey 1944: 344 (♂, Fonte Boa, Amazonas, Brazil). Barretto 1947a: 244 (listed).

Lutzomyia souzacastroi: Theodor 1965: 189 (listed). Forattini 1973: 320 (♂ fig., tax.). Martins et al. 1975e: 651 (♂ fig., cf. to cuzquena)

Distribution (Map 26-5). Brazil (Martins et al. 1978).

Remarks. Plate 26-10 is based on the holotype male of L. souzacastroi stored in the USNM and examined by us in 1986.

Lutzomyia (Psathyromyia) scaffi (Damasceno & Arouck)

Plate 26-11

Phlebotomus scaffi Damasceno & Arouck 1956: 6 (♂, Rio Capim, Pará, Brazil).

Lutzomyia scaffi: Theodor 1965: 185 (listed). Forattini 1973: 318 (♂ fig., tax.). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Martins et al. 1976b: 498 (♂, Peru); 1978: 108 (refs., dist.). Young 1979: 115. Morales & Minter 1981: 96 (Colombia). Morales et al. 1982: 17 (♀ descript.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 40 (Acre, Brazil). Young et al. 1985: 143 (Peru). Ready et al. 1986: 33 (Pará, Brazil). Ryan 1986: 94 (♂, ♀ figs., Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Lutzomyia volcanensis (not volcanensis Fairchild & Hertig): Leger et al. 1977: 226 (French Guiana).

Distribution (Map 26-7). Colombia (Morales & Minter 1981); Peru (Martins et al. 1978); French Guiana (Leger et al. 1977); Brazil (Lainson et al. 1976; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Suriname (1 ♂, Brownsweg, A.M. Burgos).

Remarks. The dark pleura of L. scaffi serves to separate females from those of closely related species (Morales et al. 1982; Ryan 1986).

## Lutzomyia (Psathyromyia) dendrophyla (Mangabeira)

Plate 26-12

Flebotomus dendrophylus Mangabeira 1942a: 139 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 197 (listed).

Lutzomyia dendrophyla (or dendrophila): Barretto 1962: 99 (listed). Arias & Freitas 1977: 523 (Amazonas, Brazil). Leger et al. 1977: 223 (French Guiana). Martins et al. 1978: 144 (refs., dist.). Young 1979: 113 (♂, ♀ figs., refs.). Lainson et al. 1979: 240 (natural Trypansoma infection, Pará, Brazil). Fraiha et al. 1980a: 21 (Peru). Lewis & Macfarlane 1981: 179 (mite parasite, Colombia). Morales & Minter 1981: 96 (Caqueta, Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Morales et al. 1982: 19 (♀ tax., figs.). Young & Rogers 1984: 599 (listed, Ecuador). Young et al. 1985: 143 (Peru). Hudson & Young 1985: 418 (Suriname). Geoffroy et al.

1986: 486 (French Guiana). Ready et al. 1986: 33 (Pará, Brazil). Ryan 1986: 91 (♂, ♀ figs., Brazil). Ryan et al. 1987: 356 (natural flagellate infections, Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 26-6). Colombia (Young 1979; Morales & Minter 1981); Peru (Martins et al. 1978; Llanos 1981; Young et al. 1985); Ecuador (Young 1979); Suriname (Hudson & Young 1985); French Guiana (Leger et al. 1977; Martins et al. 1978; Geoffroy et al. 1986); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Bolivia (Young 1979); Venezuela (Pifano et al. 1962).

Remarks. Lutzomyia dendrophyla, not dendrophila (see Lewis 1975b), is widespread in Amazonian forests where both sexes are often captured on tree trunks.

### Lutzomyia (Psathyromyia) pestanai (Barretto & Coutinho)

Plate 26-13

Phlebotomus pestanai Barretto & Coutinho 1941c: 144 (♂, São Paulo, Brazil). Coutinho & Barretto 1941b: 74 (♀).

Lutzomyia pestanai: Barretto 1962: 99 (listed). Theodor 1965: 189 (listed). Forattini 1973: 314 (in part, ♂, ♀ figs., tax.). Martins et al. 1978: 107 (refs., dist.). Mayrink et al. 1979: 131 (provisional ident., Minas Gerais, Brazil).

Distribution (Map 26-4). Brazil (Martins et al. 1978; Mayrink et al. 1979).

Remarks. Forattini (1973) mistakenly regards L. pestanai and L. nevesi as conspecific but the female of the latter species (Pl. 15-22) has completely different spermathecae and the antennal ascoids of both sexes lack proximal spurs.

The dorsal setae on the distal half of the paramere of L. pestanai are modified like those of L. dendrophyla but the former species lacks a well defined group of short setae on the paramere.

Barretto (1941a) described the immature stages of L. pestanai.

Lutzomyia (Psathyromyia) volcanensis (Fairchild & Hertig)

Plate 26-14

Phlebotomus volcanensis Fairchild & Hertig 1950: 528 (♂, Cerro Punta, Chiriquí, Panama); 1961b: 246 (♀).

Lutzomyia volcanensis: Theodor 1965: 189 (listed). Forattini 1973: 325 (♂, ♀ figs., tax.). Martins et al. 1978: 112 (refs., dist.). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 97 (♂, ♀ figs., dist., Costa Rica).

Distribution (Map 26-7). Panama (Fairchild & Hertig 1950); Costa Rica (Murillo & Zeledón 1985).

Remarks. The record of L. volcanensis in French Guiana (Leger et al. 1977) was a misidentification of L. scaffi. We examined slide-mounted males, labelled "L. volcanensis," from there that were kindly sent by J.P. Dedet in 1987.

## Lutzomyia (Psathyromyia) shannoni (Dyar)

Plate 26-15

Phlebotomus shannoni Dyar 1929: 121 (♂, Panama Canal Zone). Fairchild & Hertig 1950: 524 (♂, ♀ figs., refs., tax.).

Phlebotomus limai Fonseca 1935: 61 (♀, São Paulo, Brazil).

Phlebotomus bigeniculatus Floch & Abonnenc 1941b: 3 (♂, ♀, Cayenne, French Guiana).

Flebotomus shannoni: Barretto 1947a: 222 (full refs.).

Phlebotomus microcephalus Barretto & Duret 1953: 341 (Presidencia Roca, Chaco, Argentina).

Phlebotomus pifanoi Ortiz 1972a: 21 (♂, Sierra Parima, Amazonas, Venezuela).

Lutzomyia shannoni: Lainson et al. 1976: 57. Leger et al. 1977: 218 (French Guiana). Mogollon et al. 1977: 209 (Venezuela). Arias & Freitas 1977: 523 (Amazonas, Brazil). Ramirez Perez et al. 1978: 52 (Venezuela). Martins et al. 1978: 109 (refs., figs., dist.). Young 1979: 117 (refs., figs., dist.). Le Pont et al. 1980: 133 (natural infection,

flagellates, French Guiana). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 96 (Colombia). Lewis & Macfarlane 1981: 177 (mite parasite, Belize). Ramirez Perez et al. 1981: 124 (Venezuela). Morales et al. 1982: 19 (figs., tax.). Zeledón et al. 1982: 276 (Honduras). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ramirez Perez et al. 1982b: 58 (♂, ♀ figs., Venezuela). Zeledón & Murillo 1983: 280 (Nicaragua). Young & Perkins 1984: 273 (♂, ♀ figs., refs.). Aguiar & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Young & Rogers 1984: 599 (listed, Ecuador). Hashiguchi et al. 1985a: 442 (biting man, Ecuador). Hudson & Young 1985: 418 (Suriname), Young et al. 1985: 143 (Peru). Aguiar et al. 1985a: 339; 1985b: 186 (vertical dist., Brazil); 1985c: 340; 1985d: 467 (coll. data, Brazil). Murillo & Zeledón 1985: 91 (♂, ♀ figs., Costa Rica). Geoffroy et al. 1986: 486 (French Guiana). Le Pont & Desjeux 1986: 314 (Bolivia). Ready et al. 36 (Pará, Brazil). Ryan 1986: 95 (♂, ♀ figs., Pará, Brazil). Vexenat et al. 1986: 296 (common man-biter, Bahia, Brazil). Killick-Kendrick 1986: 135 (listed). Alexander 1987: 554 (flight range, Colombia). Porter et al. 1987: 929 (Guatemala). Young et al. 1987: 588 (natural flagellate infections, Colombia). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela). Endris 1987b: 413 (egg structure). Lebbe et al. 1987: 29 (computer aided ident.). Ryan et al. 1987a: 356 (natural flagellate infections, Brazil).

Distribution (Map 26-8). U.S.A. to Argentina (Martins et al. 1978 & subsequent references, listed above).

Remarks. Wild caught females of L. shannoni have been found naturally infected with flagellates in several countries, including U.S.A. (Young & Perkins 1984), Costa Rica (Zeledón & Alfaro 1973), Panama (Johnson et al. 1973), Colombia (Young et al. 1987), Brazil (Arias et al. 1985; Ryan et al. 1987a) and French Guiana (Le Pont et al. 1980). This species and its close relatives are probable vectors of Endotrypanum schaudinni of sloths (Arias et al. 1985).

Vexenat et al. (1986) consider females of L. shannoni to be highly anthropophilic in Bahia State, Brazil; elsewhere throughout its wide range, there are scattered reports of man-biting behavior.

We provisionally follow Martins et al. (1978) who believe that L. pifanoi (Ortiz) is a junior synonym of L. shannoni. Ortiz (1972a) described L. pifanoi from a single male that has since become lost (D. Feliciangeli, pers. comm.). Lutzomyia microcephala (Barretto & Duret), believed to be conspecific with L. shannoni by Forattini (1973) is listed as a distinct species by Martins et al. (1978). We tentatively agree with Forattini's conclusions because of the apparent difficulty in separating the taxa but we have not observed material referable to L. microcephala from Argentina.

The immature stages of L. shannoni were described by Barretto (1941a, as limai), Hanson (1968), and Endris et al. (1987, egg structure only).

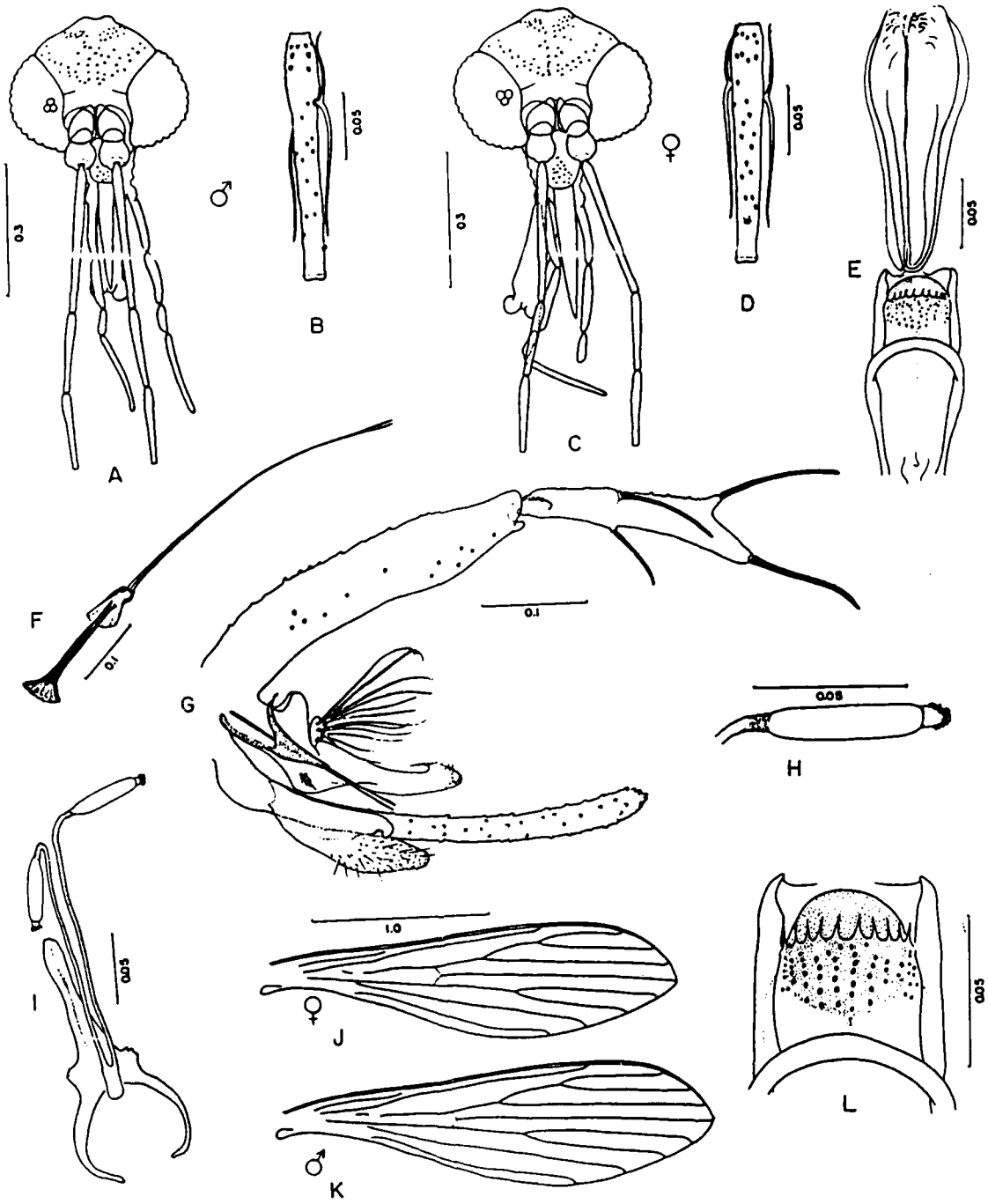



Plate 26-1

Lutzomyia dasymera. A. Male head, B. Male flagellomere II, C. Female head, D. Female flagellomere II, E. Female cibarium & pharynx, F. Genital pump & filaments, G. Male genitalia, H. Body of spermatheca, I. Spermatheca, J. Female wing, K. Male wing, L. Female cibarium (from Young 1979).

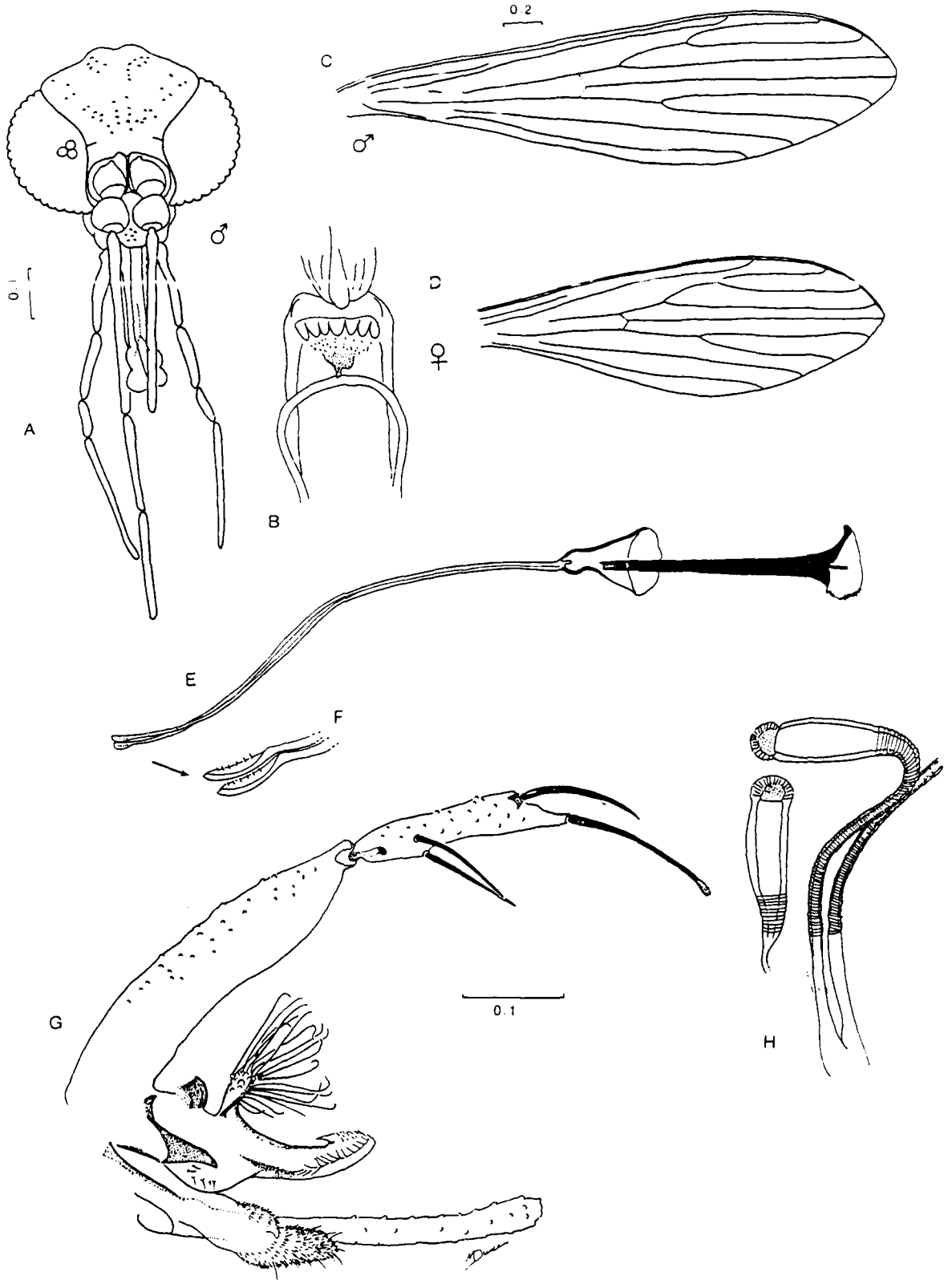



Plate 26-2

Lutzomyia campbelli. A. Male head; B. Female cibarium; C. Male wing; D. Female wing; E. Genital pump & terminalia; H. Spermathecae (figs. B, D & H from Llanos et al. 1975a).

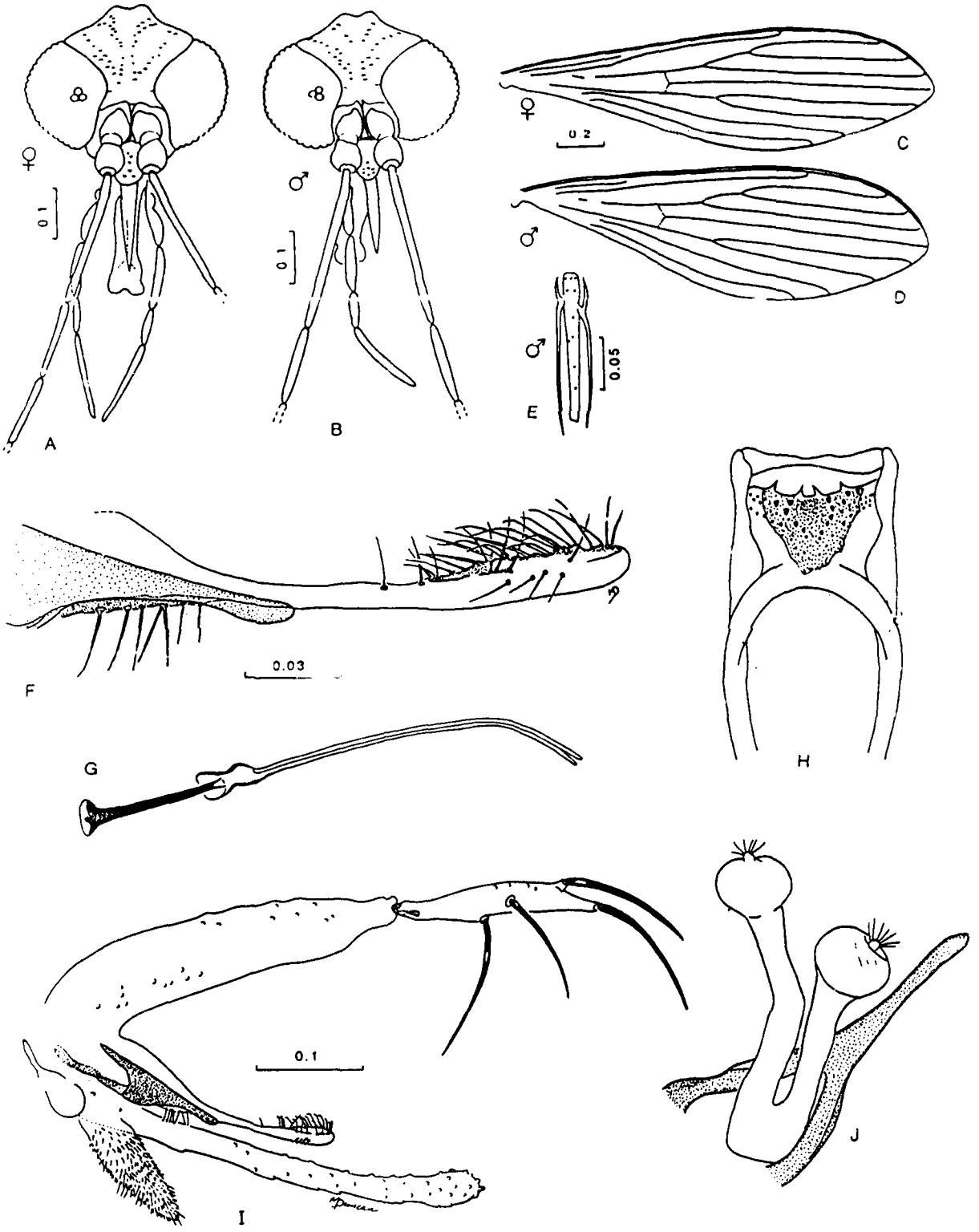



Plate 26-3

Lutzomyia lutziana. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Male aedeagus & paramere; G. Genital pump & filaments; H. Female cibarium; I. Male terminalia; J. Spermathecae.

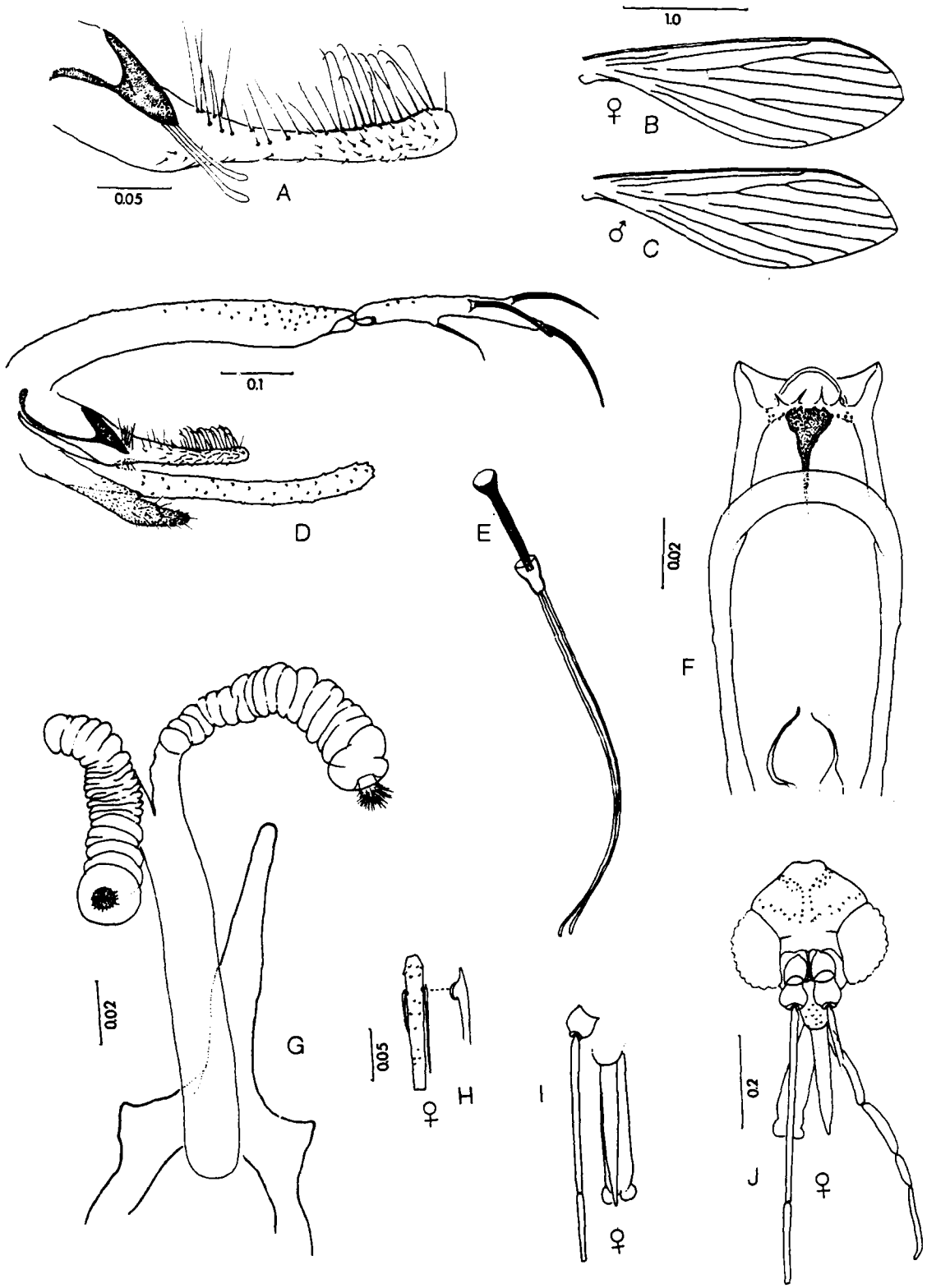



Plate 26-4

Lutzomyia guatemalensis. A. Paramere; B. Female wing; C. Male wing; D. Male terminalia; E. Genital pump & filaments; F. Female cibarium; G. Spermathecae; H. Female flagellomere II; I. Female proboscis & basal flagellomeres; J. Female head.

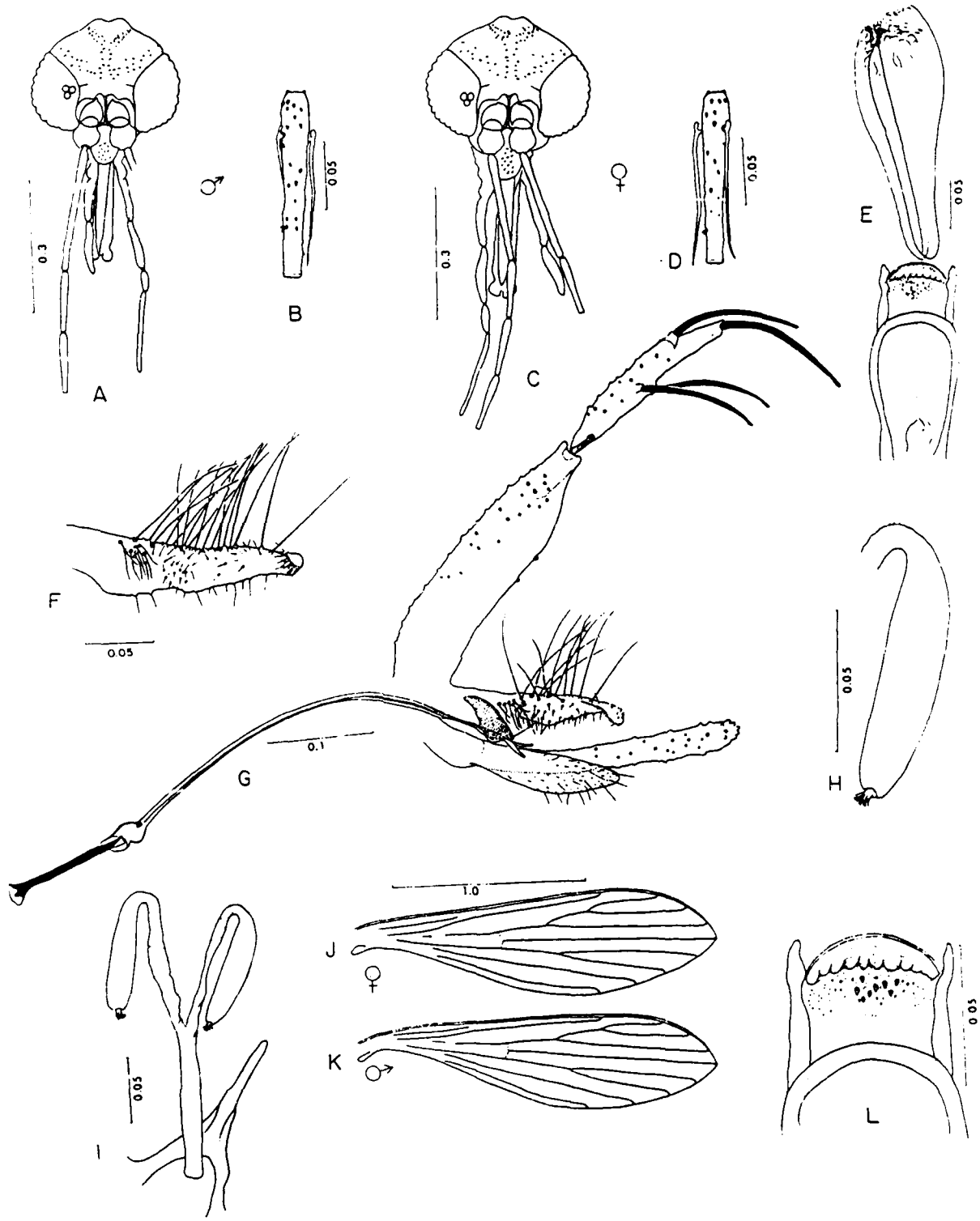



Plate 26-5

Lutzomyia punctigeniculata. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Paramere; G. Male genitalia; H. Body of spermathecae; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

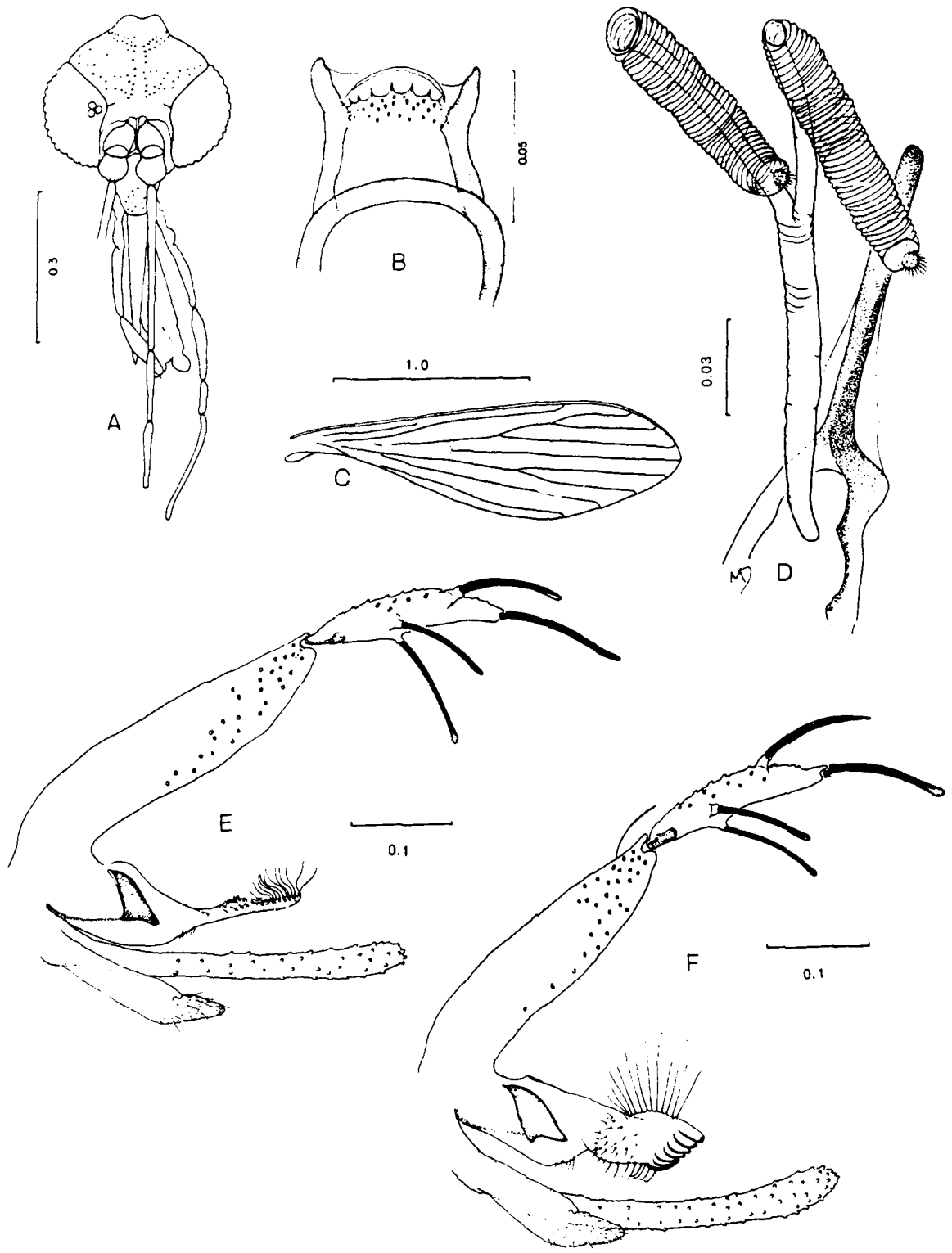



Plate 26-6

Lutzomyia undulata. A. Female head; B. Female cibarium; C. Female wing; D. Spermathecae; E. Male terminalia (all figs. except D from Young 1979).

Lutzomyia cratifer. F. Male terminalia.

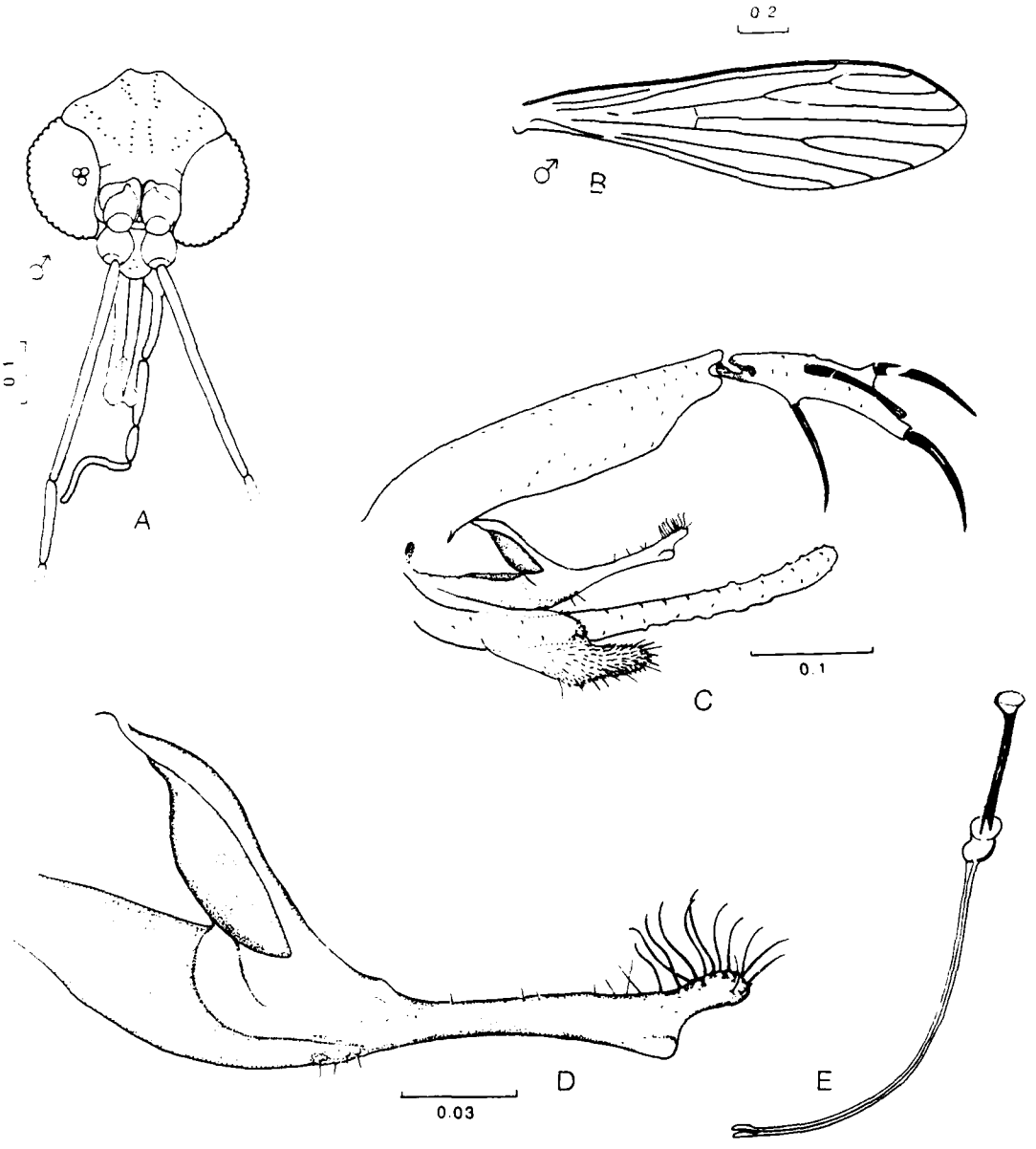



Plate 26-7

Lutzomyia soccula. A. Male head; B. Male wing; C. Male terminalia; D. Paramere; E. Genital pump & filaments.

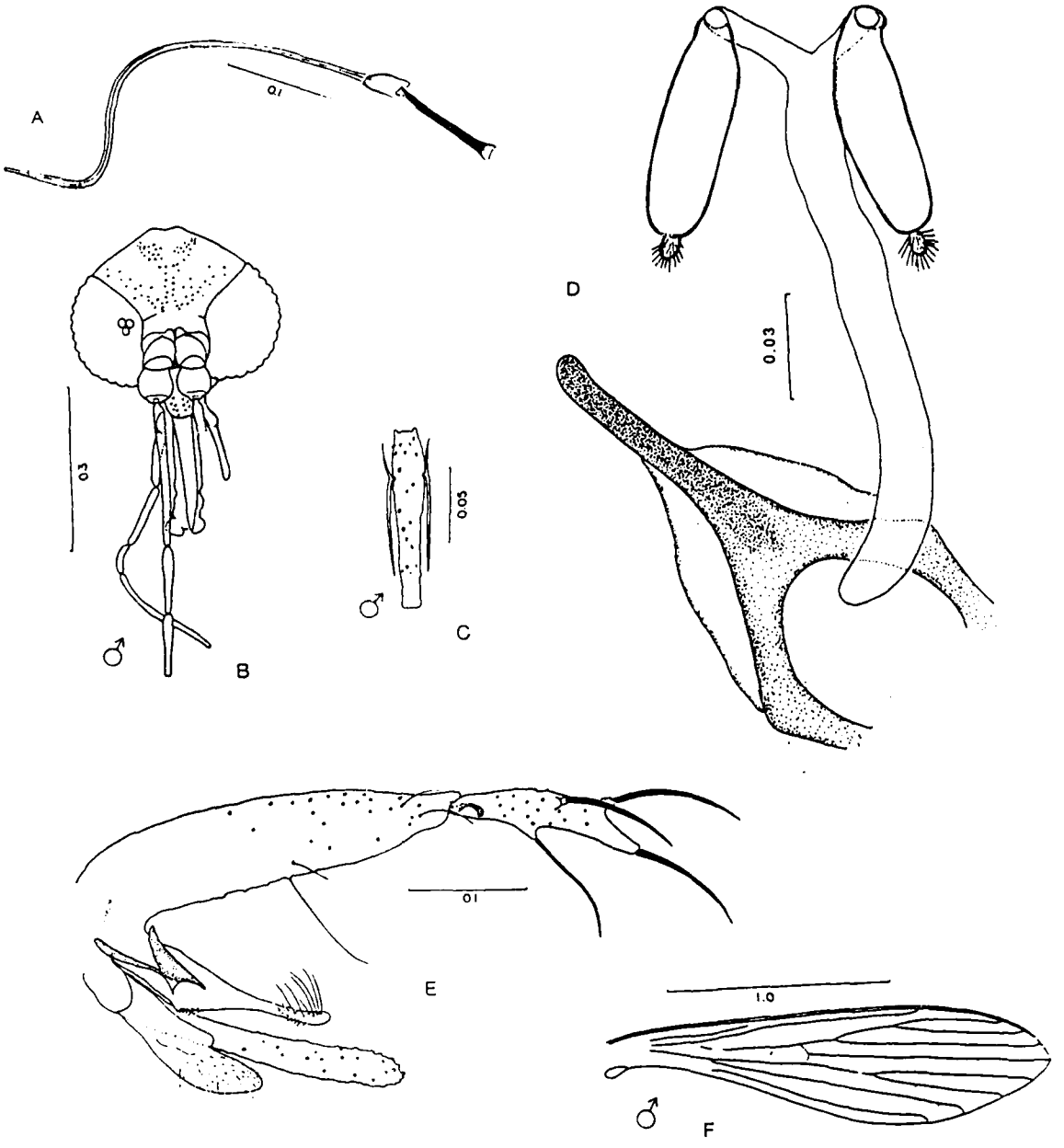



Plate 26-8

Lutzomyia abonnenci. A. Genital pump & filaments, B. Male head, C. Male flagellomere II, D. Spermathecae, E. Male terminalia, F. Male wing (all figs. from Young 1979 except fig.D)

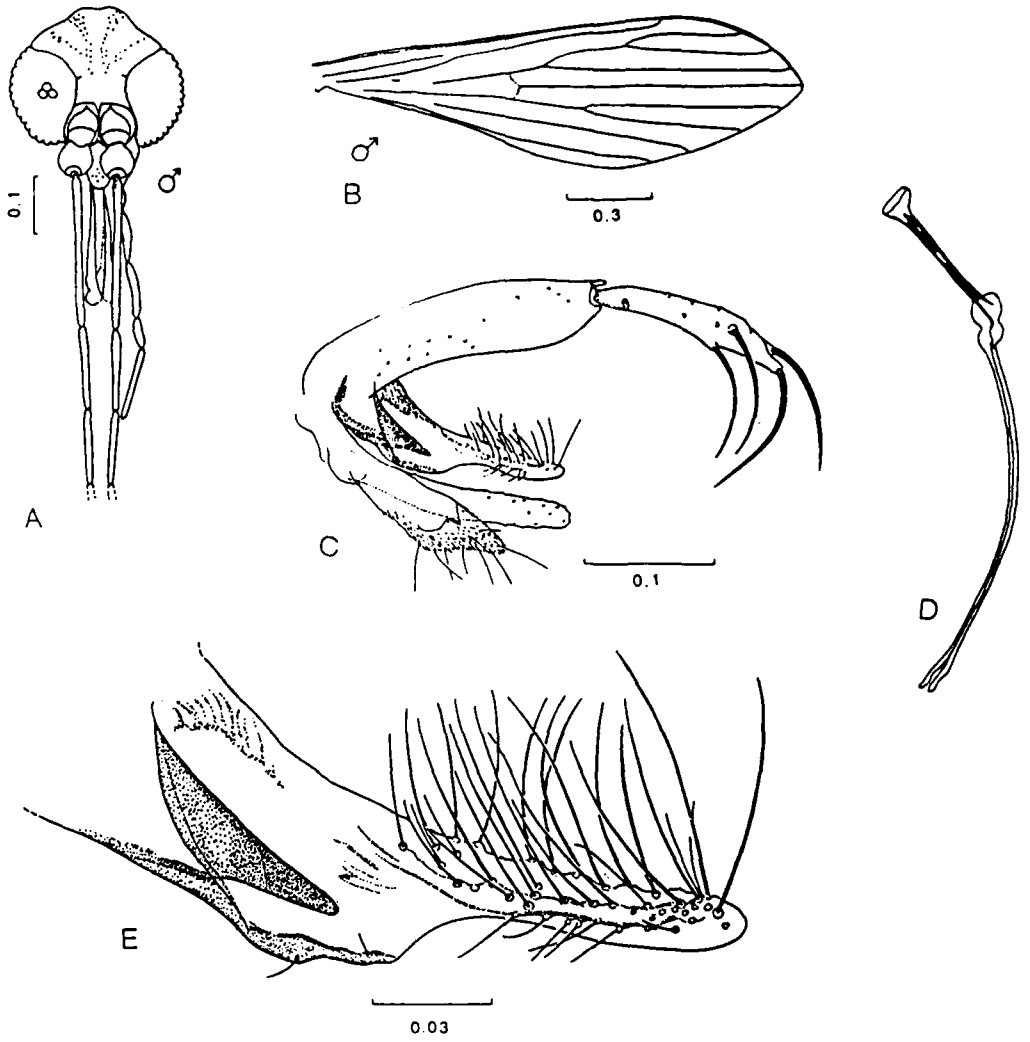



Plate 26-9

Lutzomyia cuzquena. A. Male head; B. Male wing; C. Male terminalia; D. Gential pump & filaments; E. Paramere

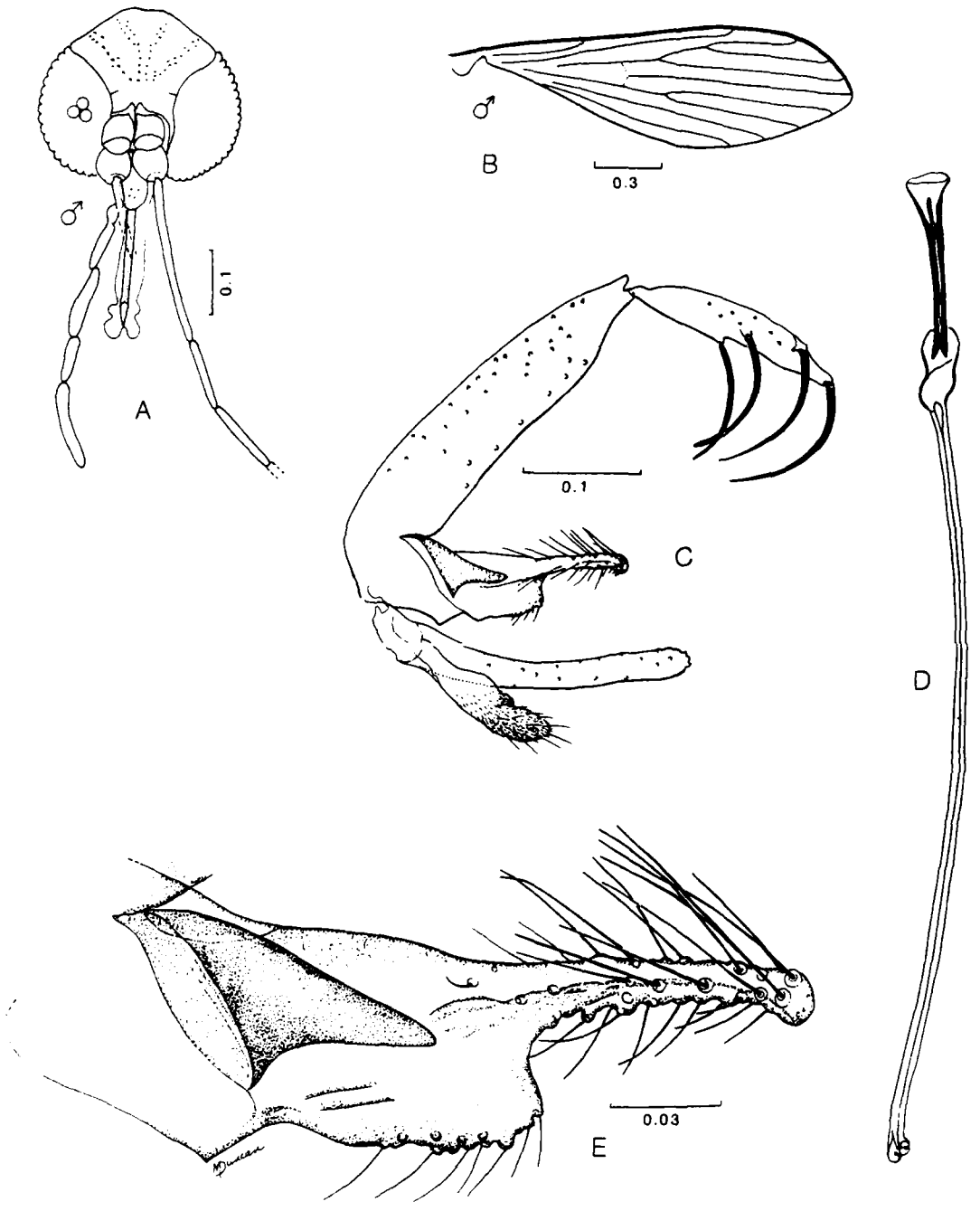



Plate 26-10

Lutzomyia souzacastroi. A. Male head; B. Male wing; C. Male terminalia; D. Genital pump & filaments; E. Paramere.

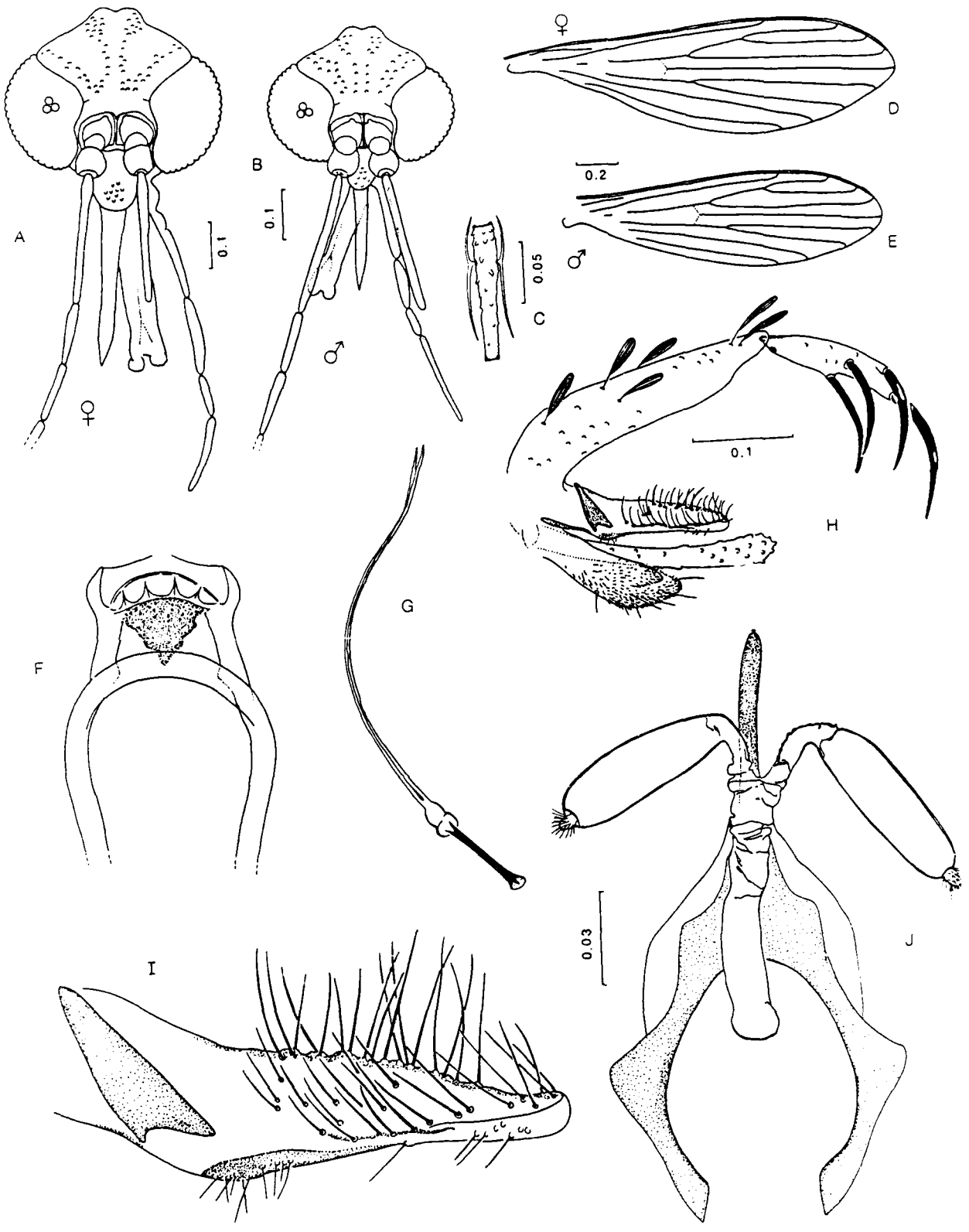



Plate 26-11

Lutzomyia scaffi. A. Female head; B. Male head; C. Male flagellomere II; D. Female wing; E. Male wing; F. Female cibarium; G. Genital pump & filaments; H. Male terminalia; I. Paramere; J. Spermathecae.

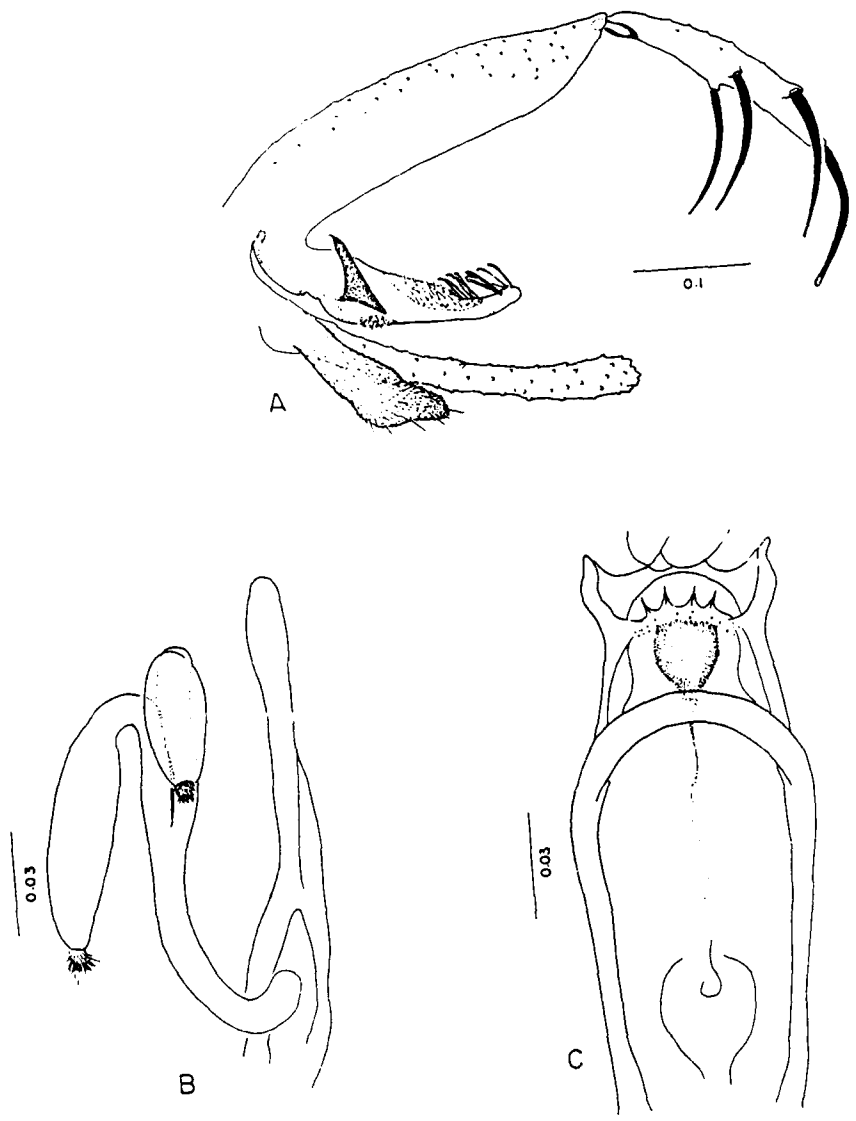



Plate 26-12

Lutzomyia dendrophyla. A. Male terminalia; B. Spermathecae; C. Female cibarium (from Young 1979).

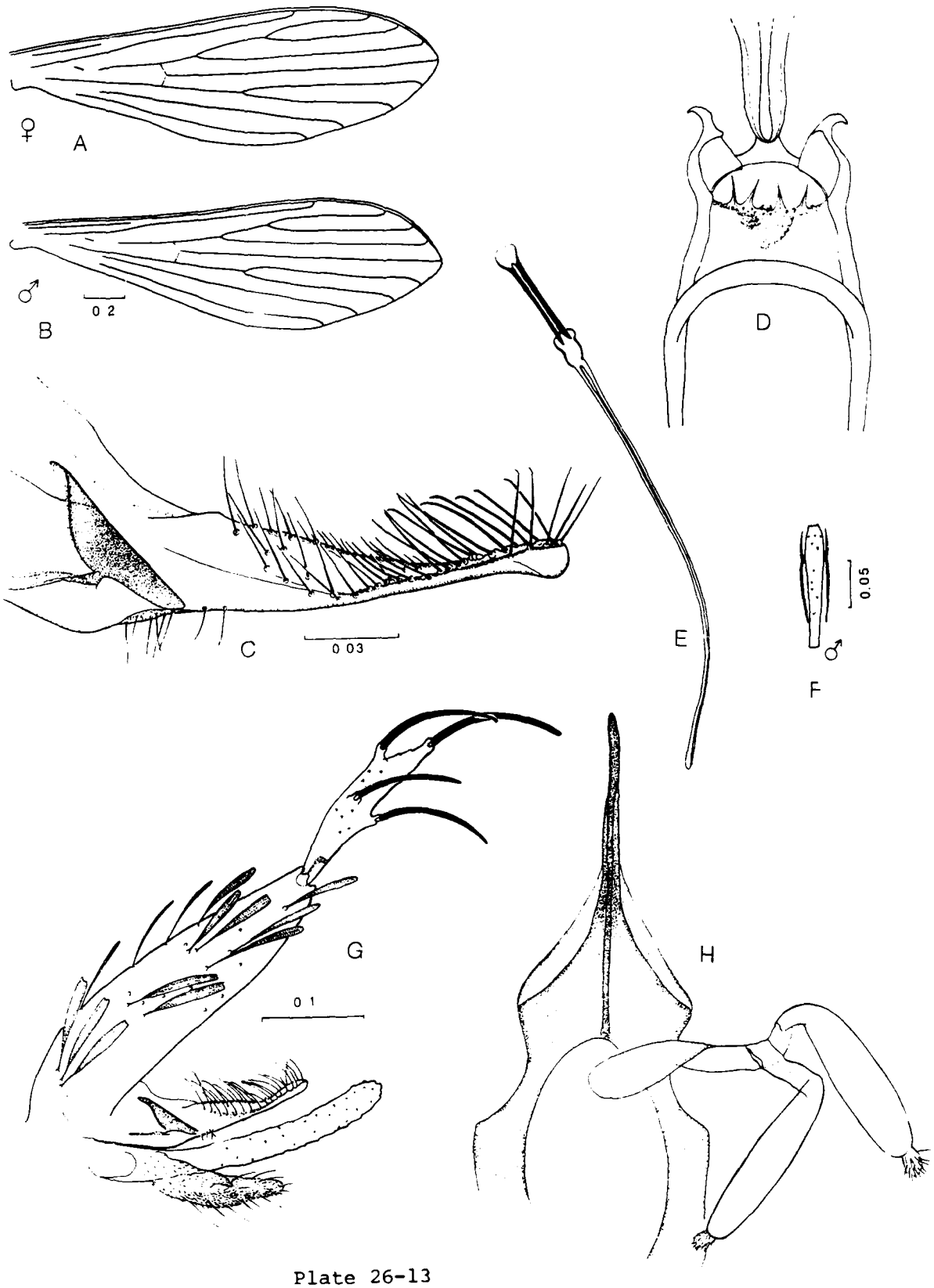



Plate 26-13

Lutzomyia pestanai. A. Female wing; B. Male wing; C. Paramere; D. Female cibarium; E. Genital pump & filaments; F. Male flagellomere II; G. Male terminalia; H. Spermathecae.

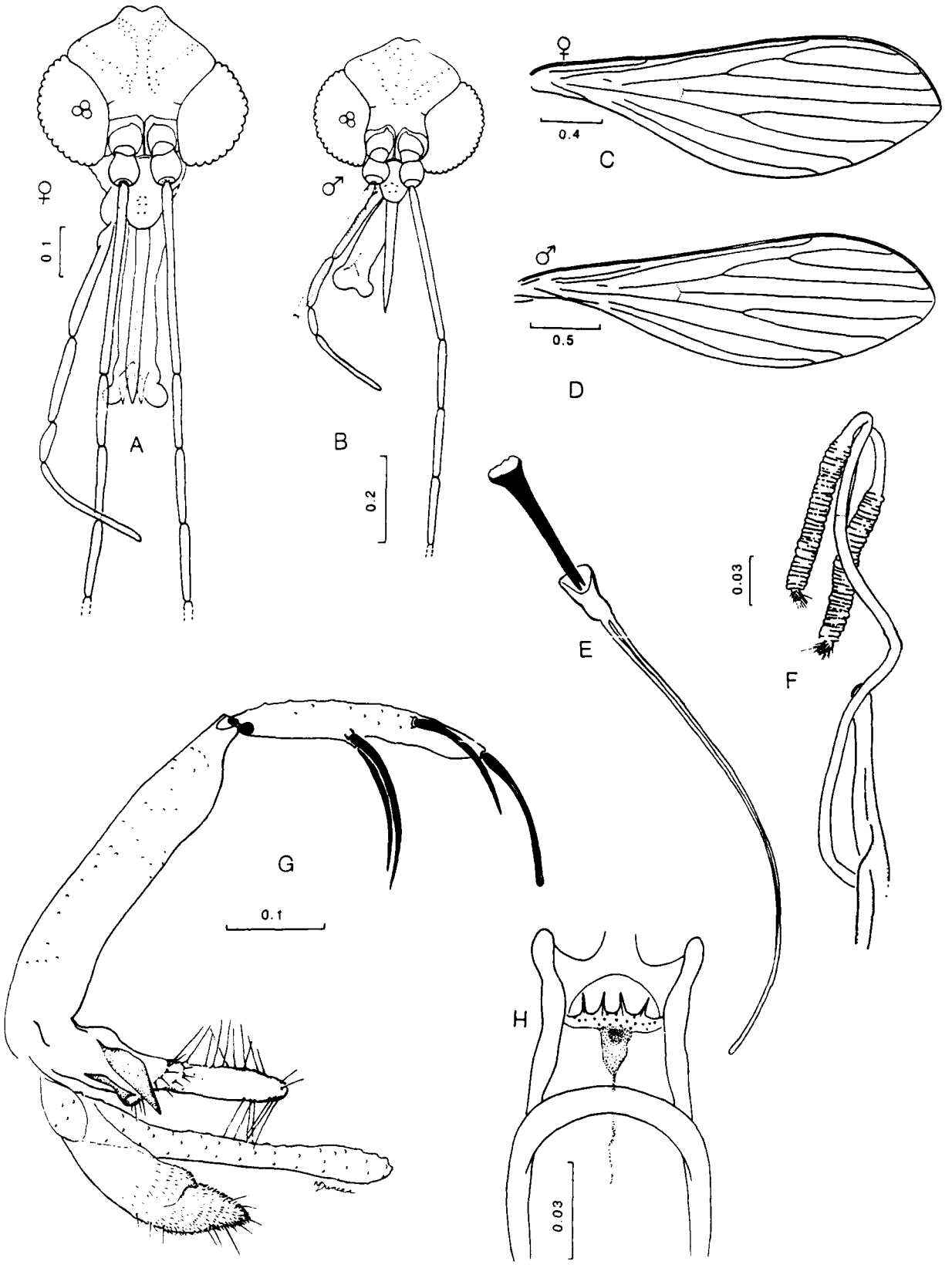



Plate 26-14

Lutzomyia volcanensis. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Genital pump & filaments; F. Spermathecae; G. Male terminalia; H. Female cibarium (fig. F from Fairchild & Hertig 1961b).

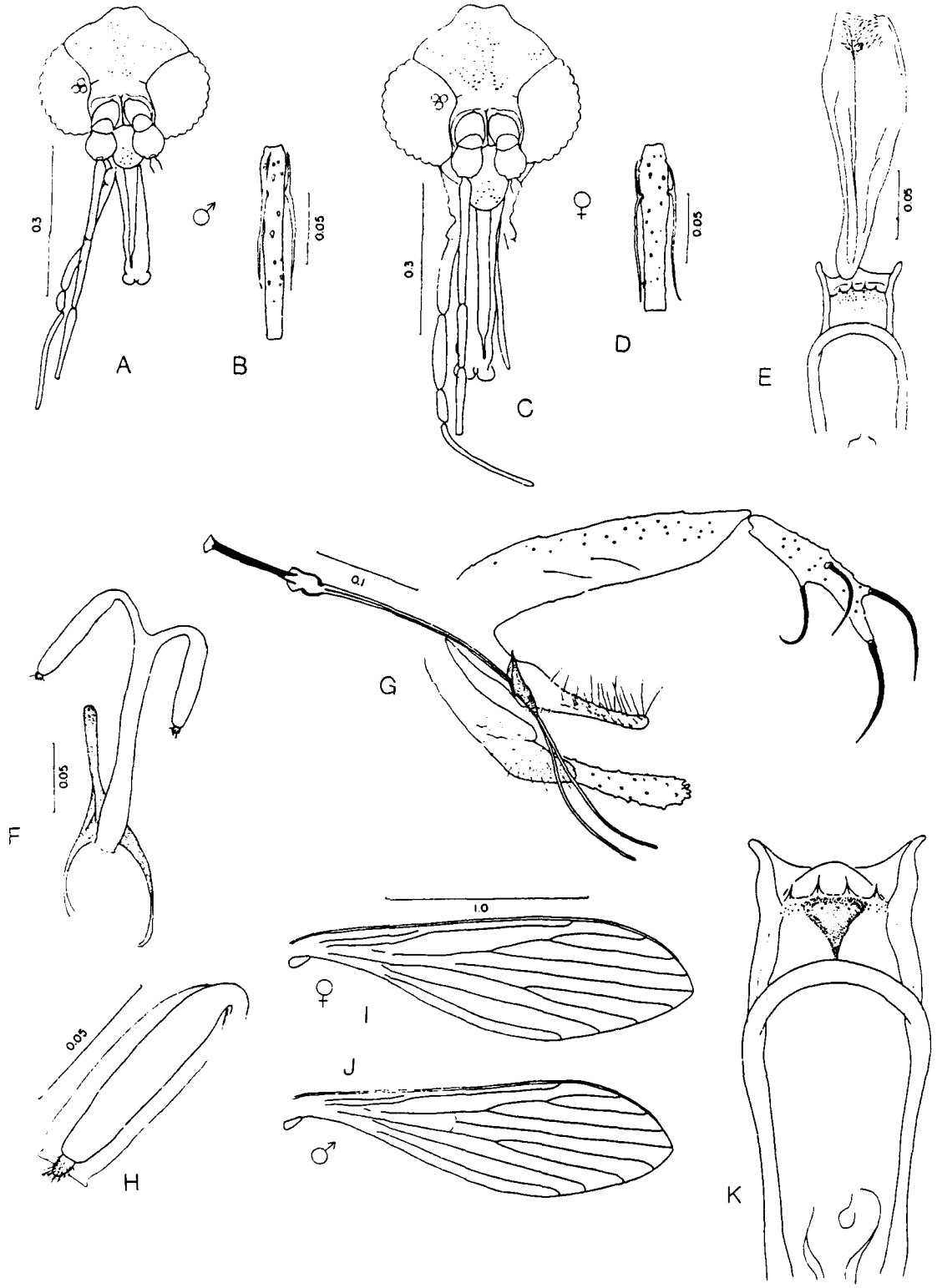



Plate 26-15

Lutzomyia shannoni. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomre II; E. Female cibarium & pharynx; F. Spermathecae; G. Male terminalia; H. Spermatheca showing outer envelope; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).




MAP 26-1


30°
15°
0°
15°
30°
45°
MAP 26-2
campbelli
cratifer

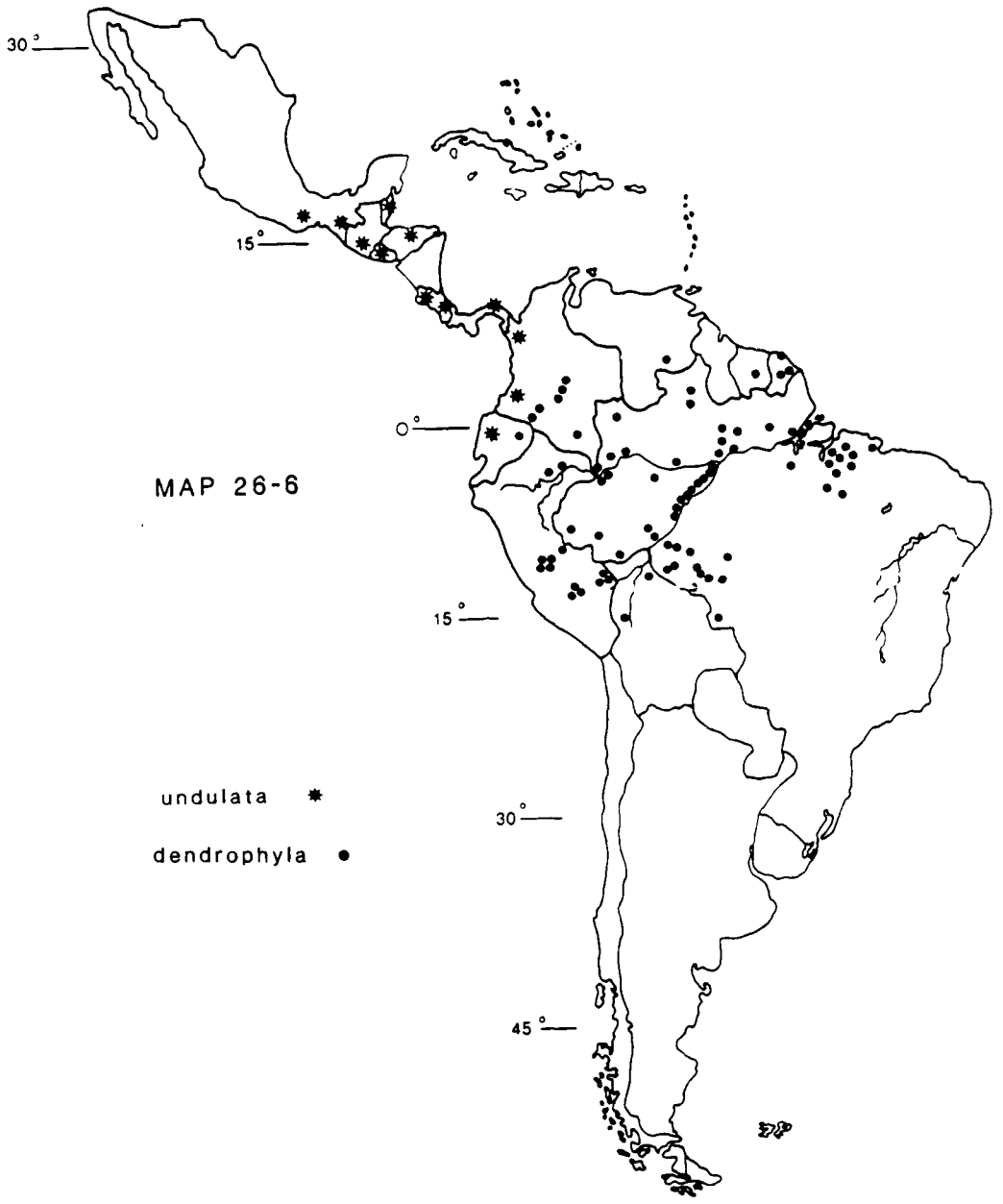

30°
15°
0°
15°
30°
45°
MAP 26-3
abonnenci
cuzquena
guatemalensis




MAP 26-4



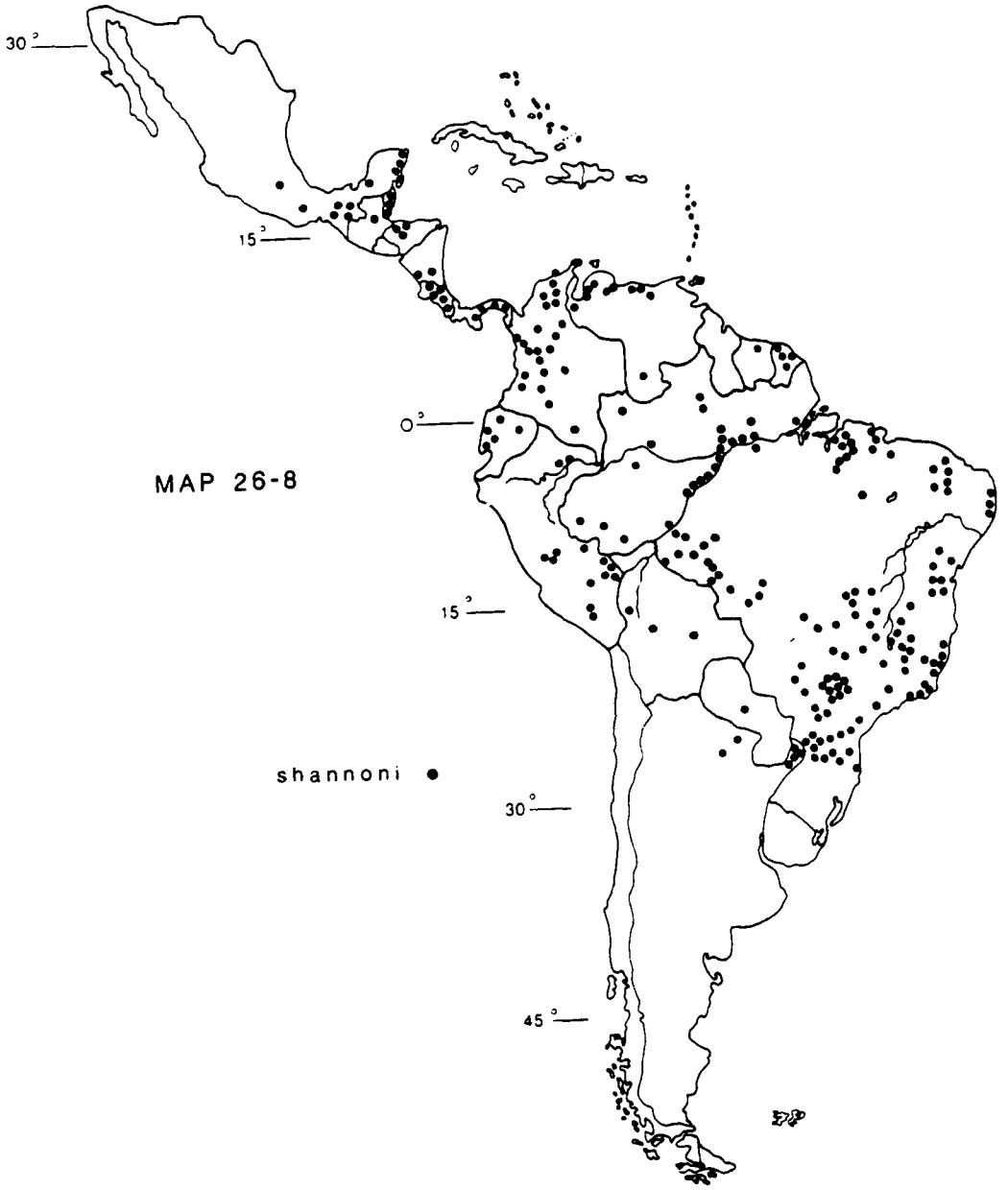

MAP 26-5




MAP 26-6




MAP 26-7




MAP 26-8

## 27. Lutzomyia Species Group Aragaoi

Lutzomyia subgenus Psathyromyia Barretto 1962: 99 (in part).

Lutzomyia species group aragaoi Theodor 1965: 185. Lewis et al. 1977: 325.

Psychodopygus subgenus Trichophoromyia: Forattini 1971a: 105; 1973: 415.

Lutzomyia species group brasiliensis Martins et al. 1978: 140 (in part).

Identification. Coloration dusky to dark. Antennal ascoids with short but distinct proximal spurs. Palpomere 5 short, subequal to palps. 3 + 4. ♀ cibarium with 4-12+ horizontal teeth; conspicuous vertical teeth in rows; dark pigment patch & usually a complete arch. Pharynx unarmed. Spermathecae subspherical or oval without incipient annulations, or cylindrical with annulations; individual sperm ducts longer than common duct. ♂ genitalia. Coxite with diffuse, short persistent setae or no persistent setae. Style with 4 spines & no subterminal seta. Genital filaments variable in length, tips modified or not. Paramere usually with dorsal basal hump, without other modifications. Lateral lobe long, extending to or beyond base of style.

The aragaoi group species are divided often into 2 series or complexes, the brasiliensis complex and aragaoi complex, based mainly on the structure of the spermathecae (see keys).

Medical Importance. Unknown; females are not anthropophilic. Both sexes of most species are commonly found resting in armadillo (Dasypus) burrows.

Key to the Males of the Species Group aragaoi

1. Genital filament tips hooked or twisted. ..... 2
   Genital filament tips inflated, spear-shaped or simple. ..... 4

2. Style with isolated proximal spine. Genital filament tips shaped like a button-hook. ..... L. carpenteri (Pl. 27-5)
   Style with paired proximal spines, i.e., inserted more or less on same level. Genital filament tips twisted. ..... 3

3. Aedeagus gradually narrowing to apex. Genital filament tip as shown. Paramere relatively slender. ..... L. coutinhoi (Pl. 27-6)
   Aedeagus with dorsal side abruptly turned downwards near apex. Genital filament tip otherwise. Paramere usually broader. ..... L. aragaoi (Pls. 27-11 & 27-12)

4. Genital filaments markedly inflated at or near their tips. ..... 5
   Genital filaments inflated slightly or not at all at or near their tips. ..... 6

5. Genital filaments inflated subterminally, followed by slender extension of filament. ..... L. inflata (Pl. 27-4)
   Genital filaments inflated at end of filaments... L. runoides (Pl. 27-8)

6. Genital filaments shorter than 7X length of genital pump. ..... 7

Genital filaments longer than 7X length of genital pump. ..... L. brasiliensis (Pl. 27-10)

7. Aedeagus nearly reaching end of paramere, with a distinct ventral heel at apex. ..... L. pascalei (Pl. 27-7)

Aedeagus shorter in relation to paramere, lacking ventral heel at apex. ..... 8

8. Genital filaments longer than 4X length of genital pump, tips slightly inflated. ..... L. abunaensis (Pl. 27-3)

Genital filaments shorter than 4X length of genital pump, tips not inflated. ..... 9

9. Lateral lobe shorter than 0.50 mm. ..... 10

Lateral lobe longer than 0.55 mm. .... L. barrettoi majuscula (Pl. 27-2)

10. Genital filaments 3X or greater pump length. ..... L. barrettoi barrettoi (Pl. 27-1)

Genital filaments shorter than 3X pump length. .... L. texana (Pl. 27-9)

Key to the females of the Species Group Aragaoi*

1. Spermathecae cylindrical with convoluted individual ducts, in part (brasiliensis complex). ..... 2

   Spermathecae subspherical, oval or pear-shaped, without convoluted individual ducts (aragaoi complex). ..... 4

2. Cibarium with 4 horizontal teeth. Spermathecae with extremely long individual ducts, each about 20X length of spermathecae. ..... L. brasiliensis (Pl. 27-10)

   Cibarium with 8 or more horizontal teeth. Spermathecae with shorter sperm ducts. ..... 3

3. *Individual sperm ducts much more slender near spermathecae than near common duct. Cibarium with vertical teeth in 3-4 irregular transverse rows. ..... L. abunaensis (Pl. 27-3)*

   Individual sperm ducts more or less subequal in width throughout & shorter. Cibarium with 1-2 rows of vertical teeth. ..... L. runoides (Pl. 27-8)

   L. inflata (Pl. 27-4)

4. Spermathecae pear-shaped, i.e., with large expanded neck; individual ducts with fine transverse striations. ..... L. carpenteri (Pl. 27-5)

   Spermathecae otherwise, subspherical or oval; individual ducts without striations. ..... 5

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*The female of L. coutinhoi remains undescribed.

5. Spermathecae subspherical. ..... 6

Spermathecae oval. ..... 7

6. Common sperm duct longer than diameter of spermatheca; terminal knob protruding from body of spermathecae. ..... L. pascalei (Pl. 27-7)

Common sperm duct invisible or barely visible, clearly much shorter than diameter of spermatheca; terminal knob presented as a flat subspherical patch from which tubules ("hairs") arise. ..... L. aragaoi (Pl. 27-10)

L. texana (Pl. 27-9)

7. Spermathecae larger, individual sperm ducts subequal throughout. ..... L. barrettoi barrettoi (Pl. 27-1)

Spermathecae smaller, individual sperm ducts noticeably expanded where they enter spermathecae.. L. barrettoi majuscula (Pl. 27-1 & 27-2)

## Lutzomyia barrettoi barrettoi (Mangabeira)

Plate 27-1

Flebotomus barrettoi Mangabeira 1942a: 148 (♂, Aurá, Belém, Pará, Brazil).

Phlebotomus sp. of Maripa Floch & Abonnenc 1946 : 3 (♂, French Guiana); 1952: 46 (♀). Leger et al. 1977: 229 (French Guiana).

Lutzomyia barrettoi: Barretto 1962: 99 (listed). Martins et al. 1976a: 488 (Peru). Leger et al. 1977: 219 (French Guiana). Martins et al. 1978: 143 (in part, dist.). Arias et al. 1985: 1101 (negative for

flagellates, Brazil). Aguiar et al. 1985d: 467 (coll. data, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Aguiar & Vilela 1987: 586 (armadillo burrow as adult resting and breeding site, Brazil).

Lutzomyia barrettoi barrettoi: Young 1979: 128 (figs. refs.). Hudson & Young 1985: 418 (Suriname). Ryan 1986: 21 (figs., Pará, Brazil).

Psychodopygus barrettoi: Forattini 1971a: 105 (listed); 1973: 457 (figs., tax., in part).

Distribution (Map 27-1). Colombia (Young 1979); French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Trinidad (Young 1979); Suriname (Hudson & Young 1985); Brazil & Peru (Martins et al. 1978).

Remarks. The spermathecae are very large, oval sacs, much larger than those of L. barrettoi majuscula or L. texana.

## Lutzomyia barrettoi majuscula Young

Plates 27-1 & 27-2

Lutzomyia barrettoi majuscula Young 1979: 129 (♂, ♀, Canal Zone, Panama). Young & Rogers 1984: 599 (listed, Ecuador). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledón 1985: 105 (♂, ♀ figs., Costa Rica).

Psychodopygus barrettoi: Forattini 1971a: 105 (listed); 1973: 457 (in part.).

Distribution (Map 27-2). Honduras (Navin et al. 1985); Nicaragua (Young 1979); Costa Rica (Young 1979; Murillo & Zeledón 1985); Panama (Fairchild & Hertig 1953a; Young 1979); Colombia & Ecuador (Young 1979).

Lutzomyia abunaensis Martins, Falcão & Silva

Plate 27-3

Lutzomyia abunaensis Martins, Falcão & Silva 1965: 17 (♂, Abuna, Rondônia, Brazil). Martins et al. 1978: 143 (as synonym of brasiliensis Mangabeira). Young 1979: 125 (Ecuador). Young & Rogers 1984: 600 (♀ descript., Ecuador).

Psychodopygus abunaensis: Forattini 1971a: 105 (listed); 1973: 452 (fig., tax.).

Distribution (Map 27-1). Brazil (type locality); Ecuador (Young & Rogers 1984).

Remarks. In view of salient differences between females of L. brasiliensis and L. abunaensis (Young & Rogers 1984), we regard the species as distinct.

Lutzomyia inflata (Floch & Abonnenc)

Plate 27-4

Phlebotomus inflatus Floch & Abonnenc 1944 : 9 (♂, Montabo, Cayenne, French Guiana). Fairchild & Hertig 1953: 34 (cf. to runoides).

Phlebotomus aragaoi (not aragaoi Costa Lima): Floch & Abonnenc 1945 : 16 (♀).

Lutzomyia inflata: Barretto 1962: 99. Leger et al. 1977: 220. Martins et al. 1978: 145 (refs., dist.). Young 1979: 135. Ready et al. 1983: 780 (Pará, Brazil); 1986: 33 (armadillo burrow, Brazil). Ryan 1986: 24 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Psychodopygus inflatus: Forattini 1971a: 105 (listed); 1973: 469 (in part, as senior synonym of runoides).

Distribution (Map 27-3). French Guiana (Leger et al. 1977; Martins et al. 1978); Brazil (Ready et al. 1983; 1 ♂, Jurua River (3°50' S, 66°10' W), Amazonas; 2 ♂♂, Madeira River near Porto Velho, Rondonia, J. Arias).

Remarks. The major difference between the males of L. inflata and L. runoides is the shape of the terminal portion of the genital filaments (Pls. 27-4 & 27-8). Forattini (1973) regards these taxa as conspecific and he may be correct; this difference could reflect intraspecific variation at the subspecies level. For the present, however, we treat them as full species pending examination of more material from different localities. We examined the holotypes of both species.

## Lutzomyia carpenteri (Fairchild & Hertig)

Plate 27-5

Phlebotomus carpenteri Fairchild & Hertig 1953a: 28 (♂, Chiva Chiva, Canal Zone, Panama).

Lutzomyia carpenteri: Barretto 1962: 99 (listed). Martins et al. 1978: 144 (refs., dist.). Young 1979: 133 (figs., refs.). Christensen & Herrer 1980b: 523 (feeding habits, Panama). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 105 (♂, ♀ figs., Costa Rica).

Psychodopygus carpenteri: Forattini 1971.

Distribution (Map 27-4): Mexico; Belize (Martins et al. 1978); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979).

## Lutzomyia coutinhoi (Mangabeira)

Plate 27-6

Flebotomus coutinhoi Mangabeira 1942a: 152 (♂, Aurá, Belém, Pará, Brazil).

Lutzomyia coutinhoi: Barretto 1962: 99 (listed). Martins et al. 1965: 2; 1976a: 488 (Peru); 1978: 144 (refs., dist.). Llanos 1981: 183 (listed). Biancardi et al. 1982: 174 (Rondonia, Brazil). Ryan 1986: 23 (♂ fig., dist., Pará, Brazil).

Psychodopygus coutinhoi: Forattini 1971a: 105 (listed); 1973: 463 (♂ fig., tax.).

Distribution (Map 27-5). Brazil (Martins et al. 1978; Biancardi et al. 1982); Peru (Llanos 1981).

## Lutzomyia pascalei (Coutinho & Barretto)

Plate 27-7

Phlebotomus pascalei Coutinho & Barretto 1940: 197 (♂, São Paulo, São Paulo, Brazil). Sherlock & Carnheiro 1962: 432 (♀ descript.). Carnheiro & Sherlock 1964: 314 (pupa).

Lutzomyia pascalei: Barretto 1962: 99 (listed). Martins et al. 1978: 145 (refs., dist.). Vexenat et al. 1986b: 296 (Bahia, Brazil).

Psychodopygus pascalei: Forattini 1971a: 105 (listed); 1973: 477 (figs., tax.). Gomes et al. 1986: 282 (São Paulo, Brazil).

Distribution (Map 27-5). Brazil & Argentina (Martins et al. 1978).

Remarks. The female of L. pascalei, described by Sherlock & Carnheiro (1962), differs from the one illustrated here by the longer common sperm duct and larger spermathecae. Our specimen was taken at Tres Bracos, Bahia, Brazil, where only males of L. pascalei and L. aragaoi have been captured. But the possibility remains that another species in the aragaoi group is also present.

## Lutzomyia runoides (Fairchild & Hertig)

Plate 27-8

Phlebotomus runoides Fairchild & Hertig 1953a: 30 (♂, ♀, Panama); Fairchild & Hertig 1959: 122 (dist., Central America). Hanson 1968: 71 (larval descript.).

Lutzomyia runoides: Barretto 1962: 99 (listed). Martins et al. 1978: (refs., dist.). Young 1979: 135 (♂, ♀ figs., refs.). Morales & Minter 1981: 96 (Caqueta, Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young et al. 1985: 143 (Peru). Murillo & Zeledón 1985: 109 (♂, ♀ figs., Costa Rica).

Psychodopygus inflatus: Forattini 1971a: 105 (listed); 1973: 469 (in part, as synonym of inflata).

Distribution (Map 27-6). Costa Rica (Murillo & Zeledón 1985); Panama. (Martins et al. 1978); Colombia (Young 1979; Morales & Minter 1981); Peru (Young et al. 1985); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982).

## Lutzomyia texana (Dampf)

Plate 27-9

Phlebotomus texanus Dampf 1938: 119 (♂, ♀, San Antonio, Texas, U.S.A.).

Lutzomyia texana: Barretto 1962: 99 (listed). Martins et al. 1978: . Young 1979: 131 (♀ fig.). Young & Perkins 1984: 276 (full refs., figs.).

Psychodopygus texanus: Forattini 1971a: 105; 1973: 480 (figs., tax.).

Distribution (Map 27-1). U.S.A. (Young & Perkins 1984); Mexico (Vargas & Najera 1953b).

Remarks. This species is closely associated with armadillos in southern Texas, U.S.A., and is readily attracted to light (Young & Perkins 1984).

## Lutzomyia aragaoi (Costa Lima)

Plates 27-11 & 27-12

Flebotomus aragaoi Costa Lima 1932: 48 (♂, Lassance, Minas Gerais, Brazil). Barretto 1947a: 185 (refs.).

Phlebotomus aragaoi: Fairchild & Hertig 1953a: 21 (♂, ♀ figs., tax.).

Phlebotomus heckenrothi Floch & Abonnenc 1942b: 8 (♀, French Guiana). Forattini 1973: 456 (as synonym of aragaoi).

Lutzomyia aragaoi: Barretto 1962: 99 (listed). Leger et al. 1977: 219 (French Guiana). Martins et al. 1978: 142 (dist., figs.). Young 1979: 126 (figs., refs.). Fraiha et al. 1980b: 21 (Peru). Morales & Minter 1981:96 (Caqueta, Colombia). Biancardi et al. 1982: 174 (Rondonia,

Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Young et al. 1985: 143 (Peru). Murillo & Zeledón 1985: 102 (♂, ♀ figs., Costa Rica). Geoffroy et al. 1986: 486 (French Guiana). Ready et al. 1986: 33 (Pará, Brazil). Ryan 1986: 20 (figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.). Ryan et al. 1987a: 356 (negative for flagellates, Brazil).

Distribution (Map 27-7). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Morales & Minter 1981); Peru (Fraiha et al. 1980b; Llanos 1981; Young et al. 1985); Bolivia (♂♂, La Paz Dept., 1985, F. LePont); Paraguay (Martins et al. 1978); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); French Guiana (Leger et al. 1977; Martins et al. 1978); Trinidad (Young 1979).

Remarks. Males of L. aragaoi from different localities show considerable variation in the shape of their parameres (Pl. 27-11). The significance of these observations is not yet known.

Lutzomyia brasiliensis (Costa Lima)

Plate 27-10

Flebotomus brasiliensis Costa Lima 1932: 48 (♂, Lassance, Minas Gerais, Brazil). Barretto 1947a: 190 (refs.).

Phlebotomus oliverioi Barretto & Coutinho 1941e: 223 (♂, Osasco, São Paulo, Brazil). Forattini 1973: 452 (as synonym of brasiliensis).

Lutzomyia brasiliensis: Barretto 1962: 99 (listed). Theodor 1965: 186 (♀ fig.). Leger et al. 1977: 219 (French Guiana). Martins et al. 1978: 143 (refs.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ryan et al. 1984: 547 (Pará, Brazil). Porter & Young 1986: 242 (cf. to guatemalensis). Ryan 1986: 22 (figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Lutzomyia oliverioi: Theodor 1965: 184. Ready & Fraiha 1981: 710 (in subgenus Nyssomyia).

Phlebotomus brasiliensis: Mangabeira & Sherlock 1962: 312 (♂, ♀ descript., immatures).

Psychodopygus brasiliensis: Forattini 1971a: 105 (listed); 1973: 460 (figs., tax.).

Distribution (Map 27-4). French Guiana (Leger et al. 1977); Brazil (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986).

Remarks. Lutzomyia oliverioi has been placed in the subgenus Nyssomyia by Theodor (1965), with a query, and by Martins et al. (1978) and Ready & Fraiha (1985) with certainty. Forattini (1973), however, studied the holotype and concluded that it was conspecific with L. brasiliensis.

Based solely on the original description and illustrations of L. oliverioi, there are character states that suggest it belongs in the aragaoi group. These include the broad wing, paramere with proximal hump and subterminal spine of the style inserted on a well marked tubercle. On the other hand, palpomere 5 of L. oliverioi is shorter than palp. 3 and, according to Ready & Fraiha (1985), the antennal ascoids lack proximal spurs and the scutum is darker than the pleura. Evidently, they did not examine the holotype of L. oliverioi to examine the latter two character states. The presence of ascoid spurs was not mentioned in the original description; but if they are present, then L. oliverioi is probably conspecific with L. brasiliensis or another aragaoi group species.

Young et al. (1985) reported L. brasiliensis (1 ♂) from Tambopata Reserve, Madre de Dios, Peru, but this is a probable misidentification. The Peruvian male has relatively short genital filaments (4X pump length). More specimens are needed to draw firm conclusions on its identity.

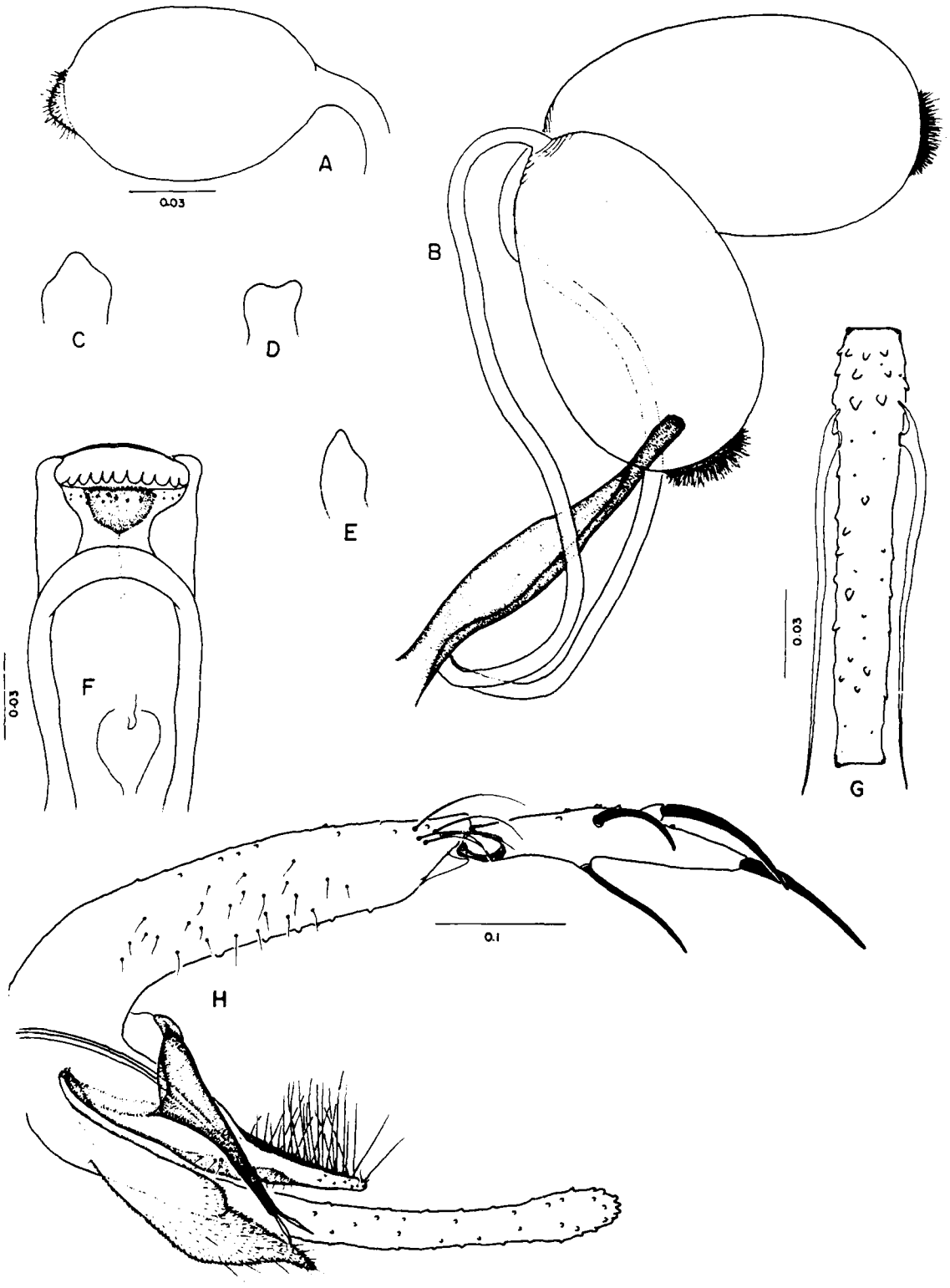



Plate 27-1

Lutzomyia barrettoi majuscula. A. Spermatheca.

Lutzomyia barrettoi barrettoi. B. Spermathecae; C., D., E. Tips of genital fork stems; F. Female cibarium; G. Female flagellomere II; H. Male terminalia (from Young 1979).

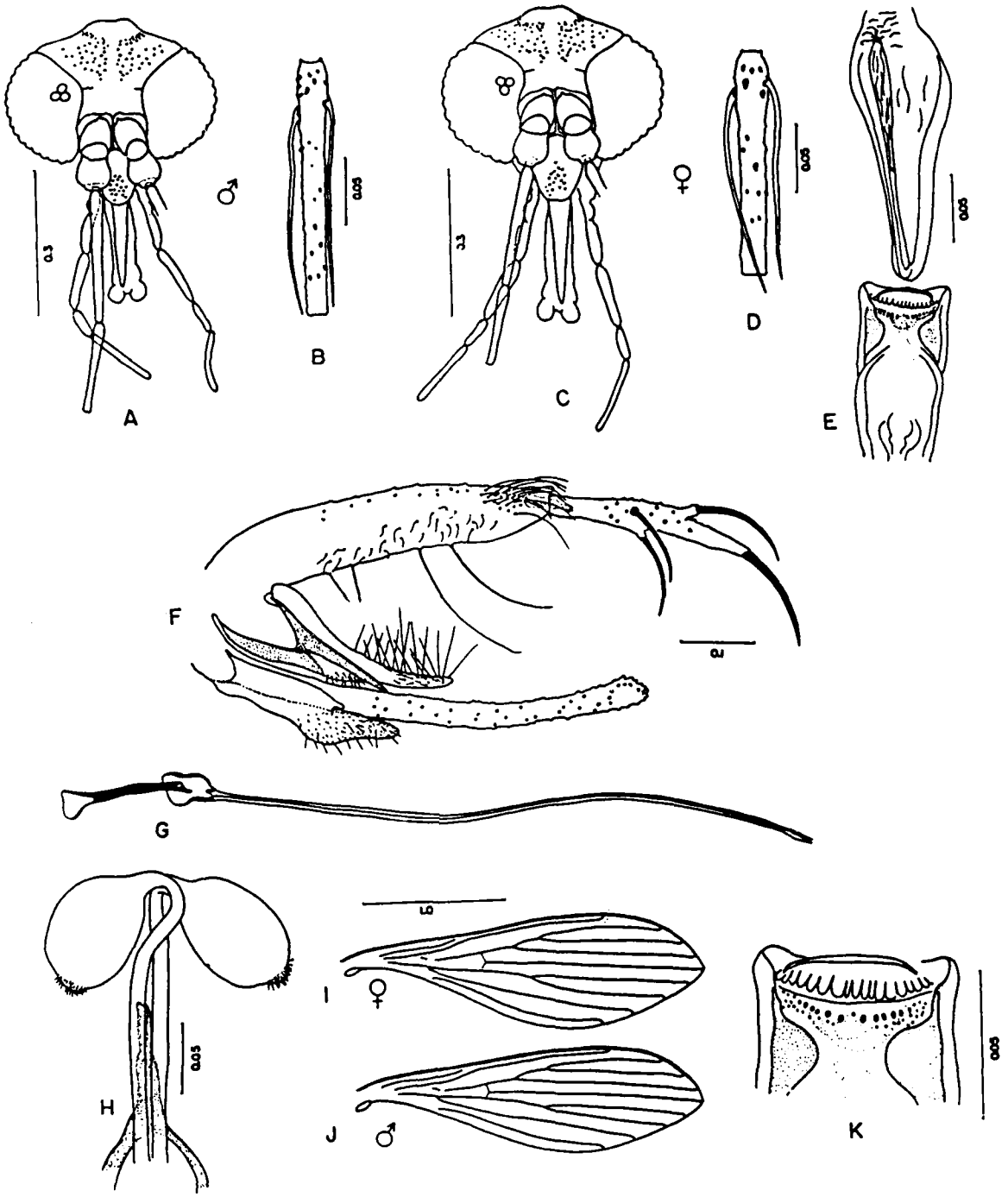



Plate 27-2

Lutzomyia barrettoi majuscula. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

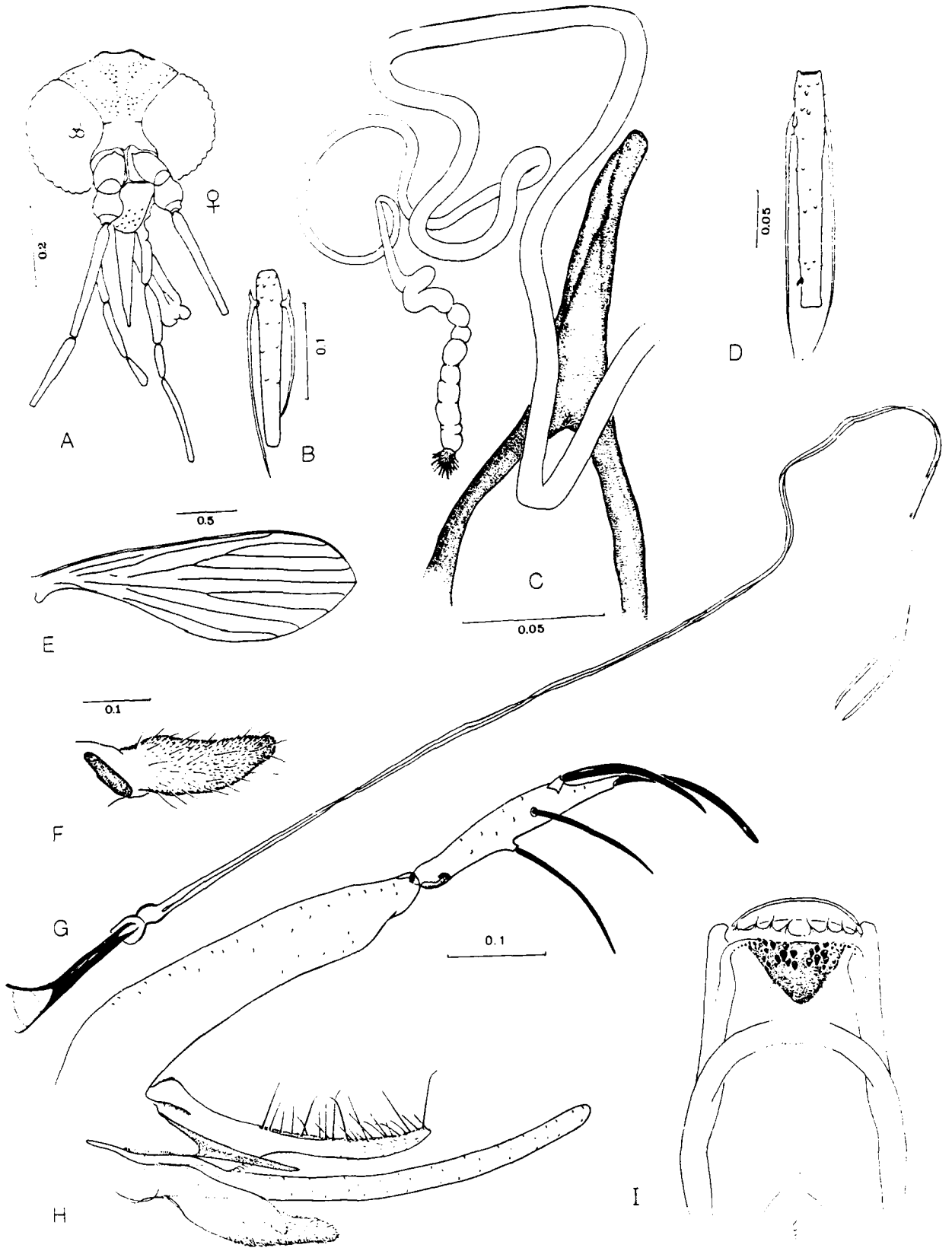



Plate 27-3

Lutzomyia abunaensis. A. Female head; B. Male flagellomere II; C. Spermathecae; D. Female flagellomere II; E. Female wing; F. Female cercus; G. Genital pump & filaments; H. Male terminalia; I. Female cibarium.

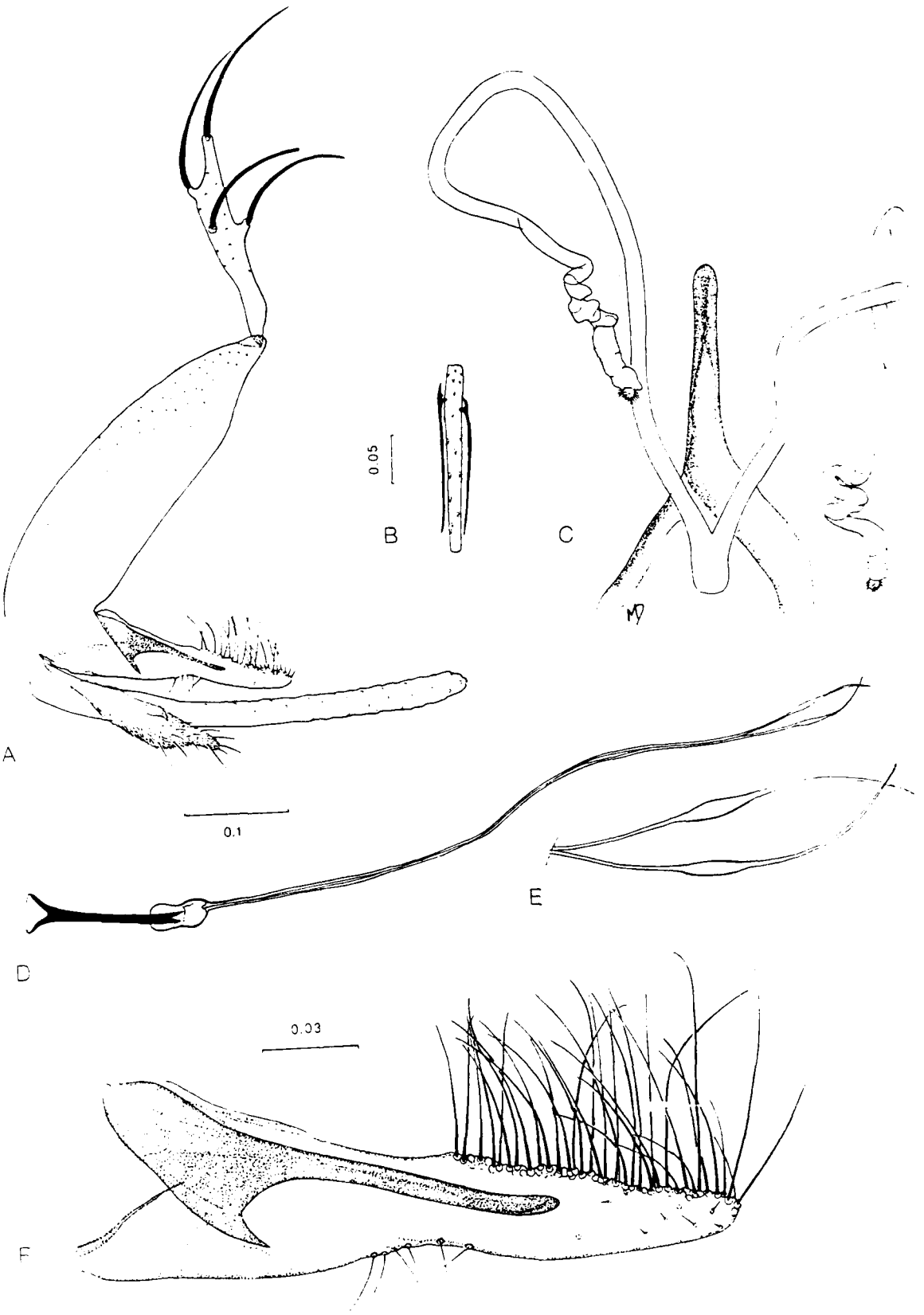



Plate 27-4

Lutzomyia inflata. A. Male terminalia; B. Male flagellomere II; C. Spermathecae; D. Genital pump & filaments; E. Tips of genital filaments; F. Paramere.

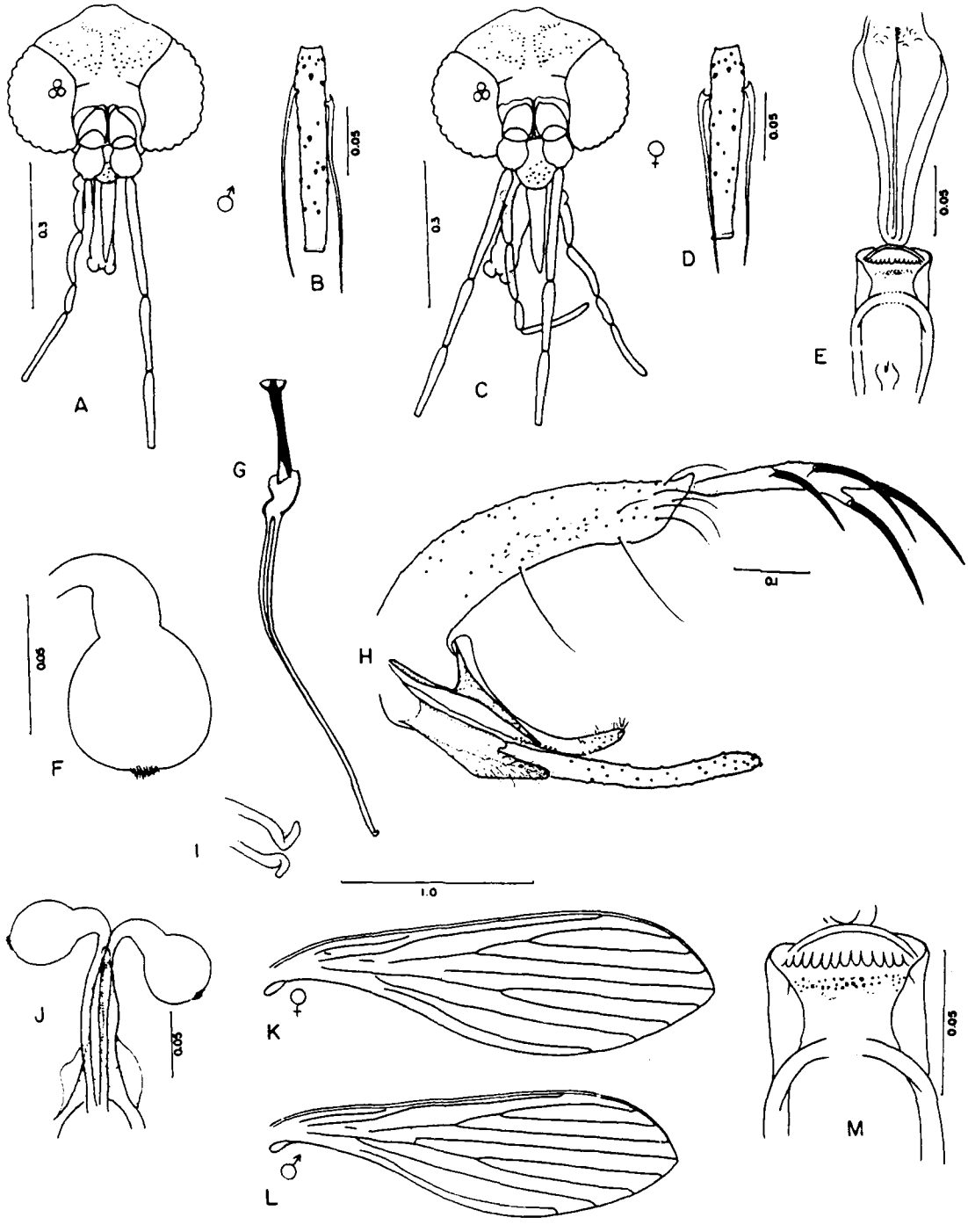



Plate 27-5

Lutzomyia carpenteri. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Body of spermathecae; G. Genital pump & filaments; H. Male genitalia; I. Tips of genital filaments; J. Spermathecae; K. Female wing; L. Male Wing; M. Female cibarium (from Young 1979).

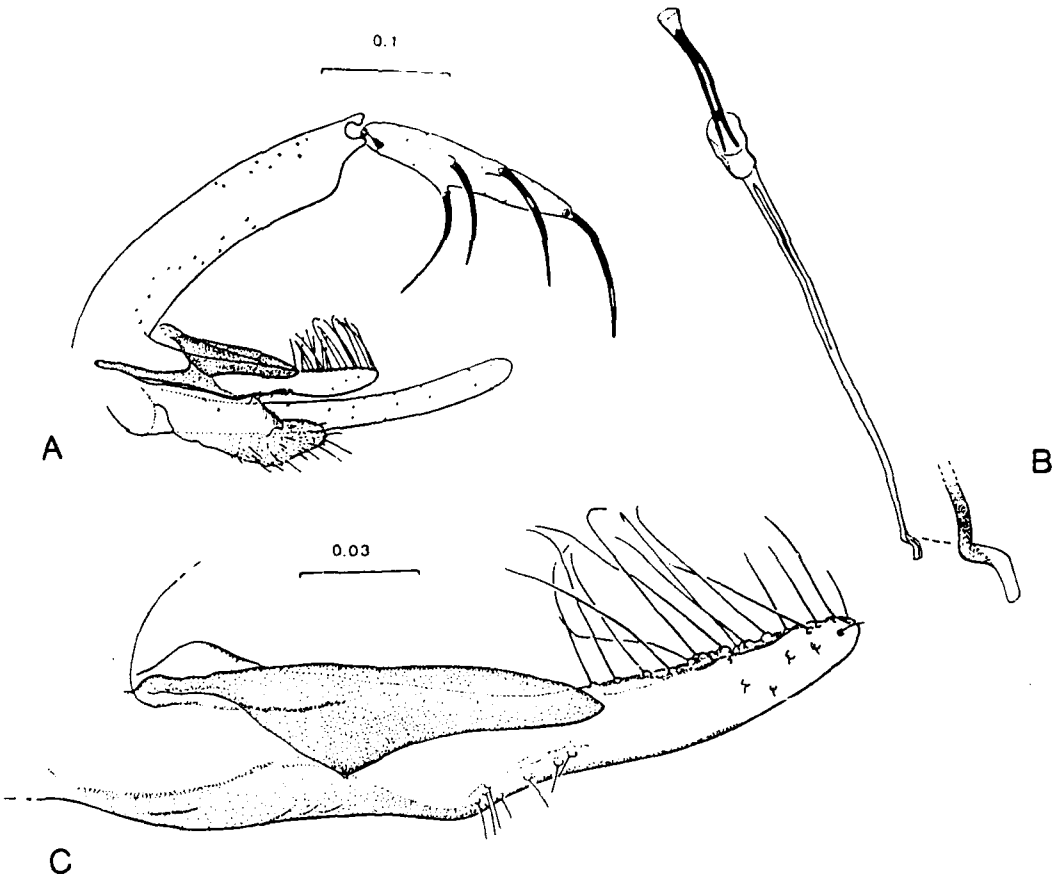



Plate 27-6

Lutzomyia coutinhoi. A. Male terminalia; B. Genital pump & filaments; C. Paramere & aedeagus, enlarged.

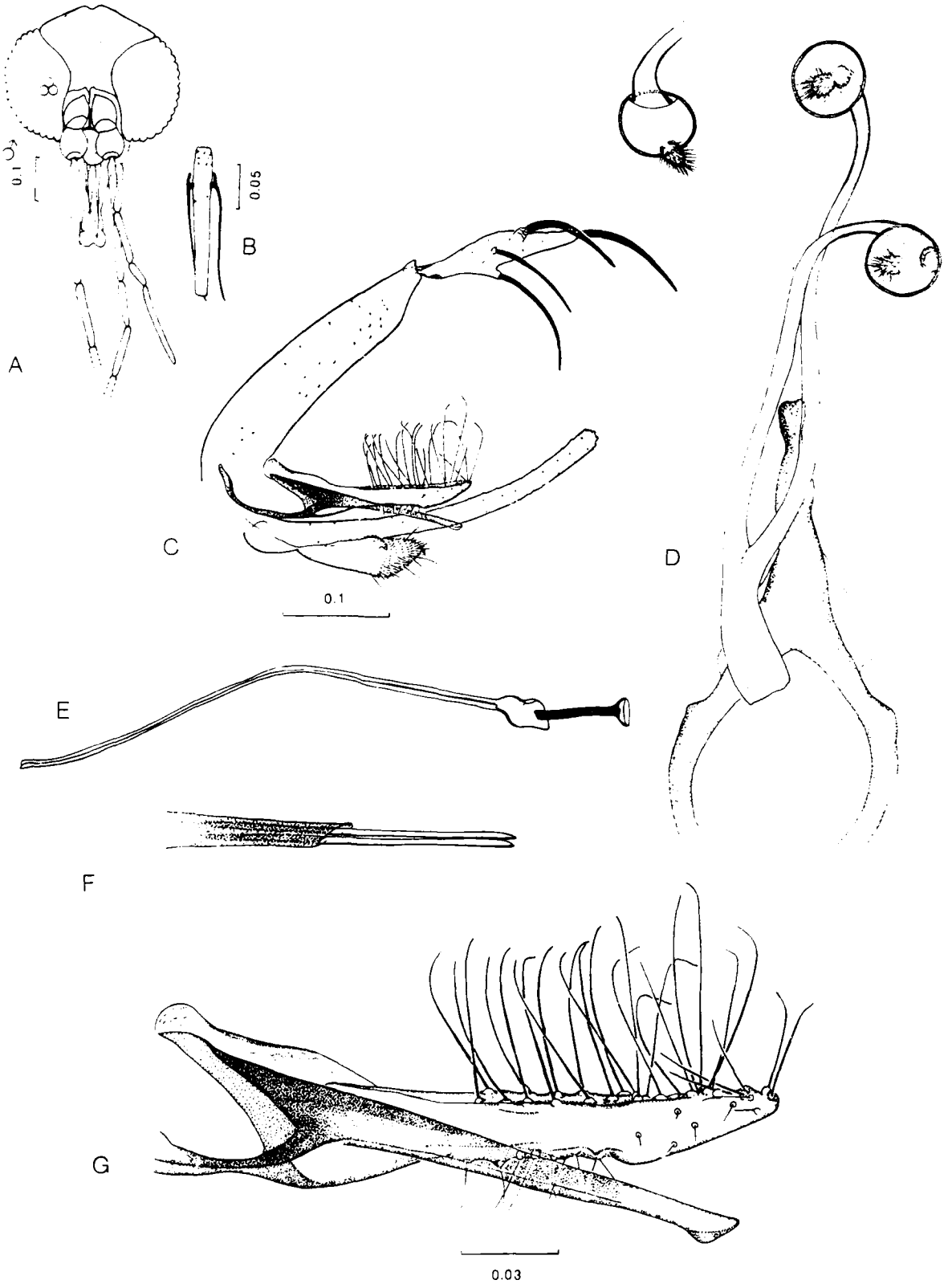



Plate 27-7

Lutzomyia pascalei. A. Male head; B. Male flagellomere II; C. Male terminalia; D. Spermathecae; E. Genital pump & filaments; F. Tips of genital filaments; G. Paramere.

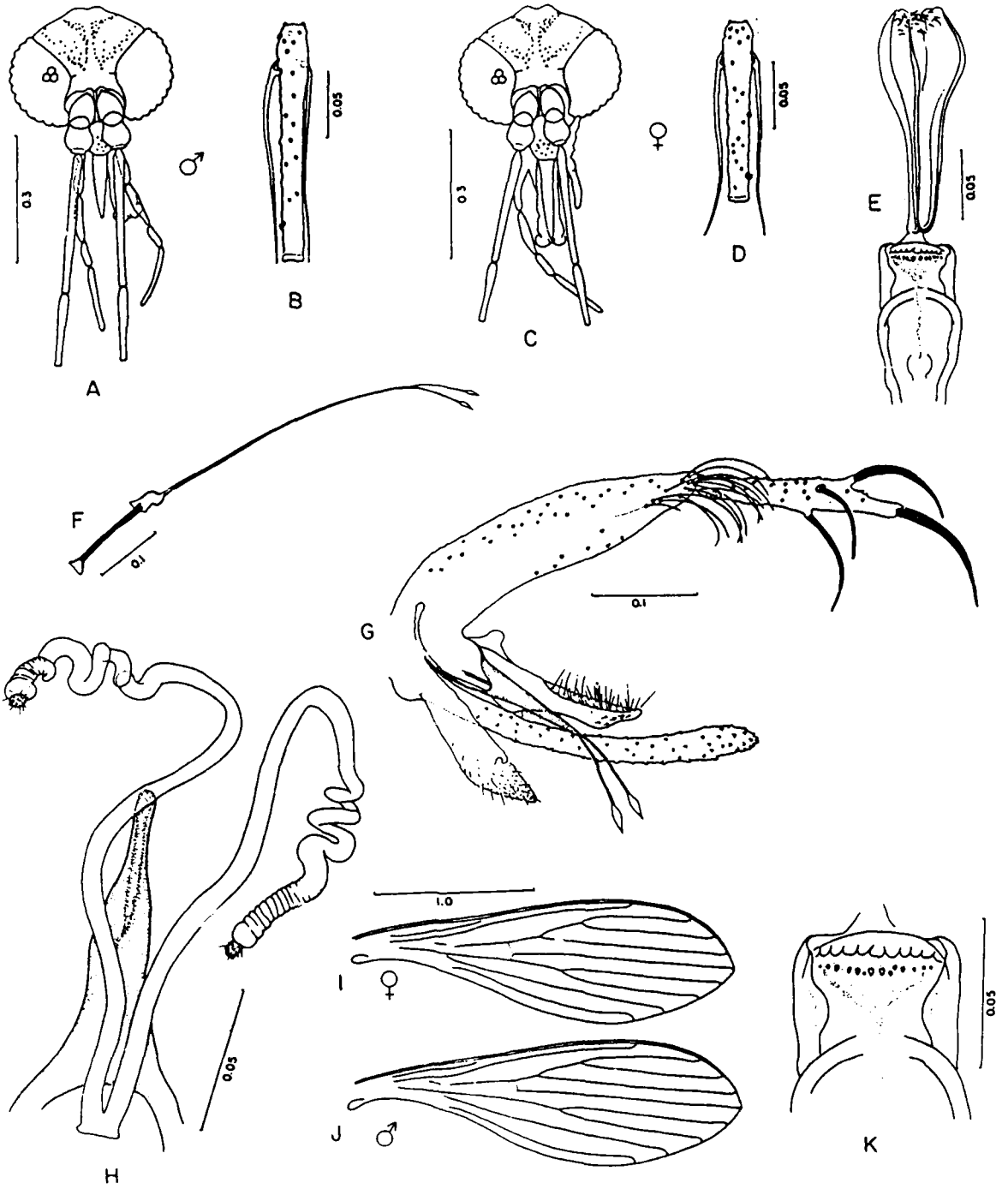



Plate 27-8

Lutzomyia runoides. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male genitalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

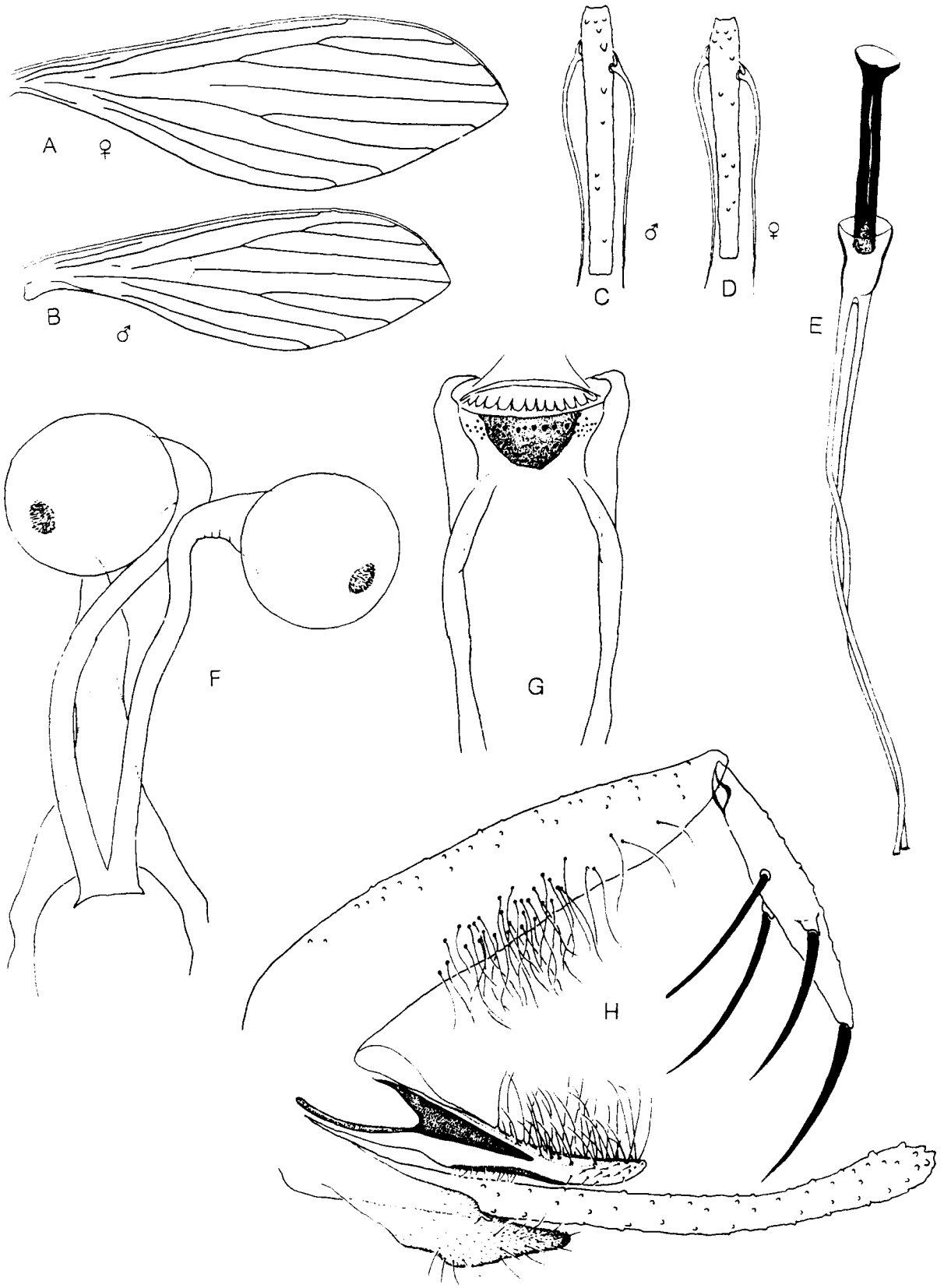



Plate 27-9

Lutzomyia texana. A. Female wing; B. Male wing; C. Male flagellomere II; D. Female flagellomere II; E. Genital pump & filaments; F. Spermathecae; G. Female cibarium; H. Male terminalia (from Young & Perkins 1984).

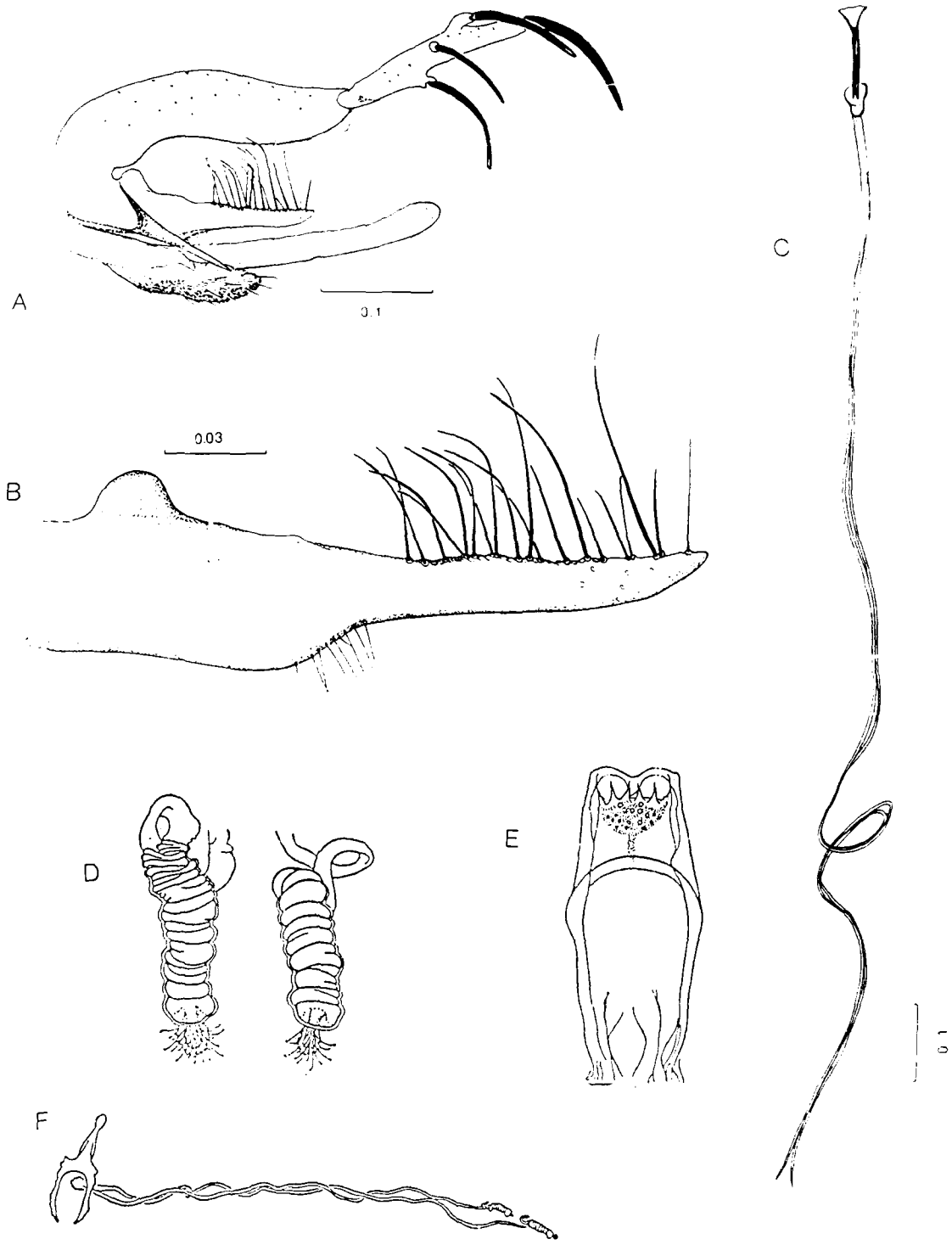



Plate 27-10

Lutzomyia brasiliensis. A. Male terminalia; B. Paramere; C. Genital pump & filaments; D. Spermathecae; E. Female cibarium; F. Spermathecae showing individual ducts (♀ figs. after Mangabeira & Sherlock 1962).

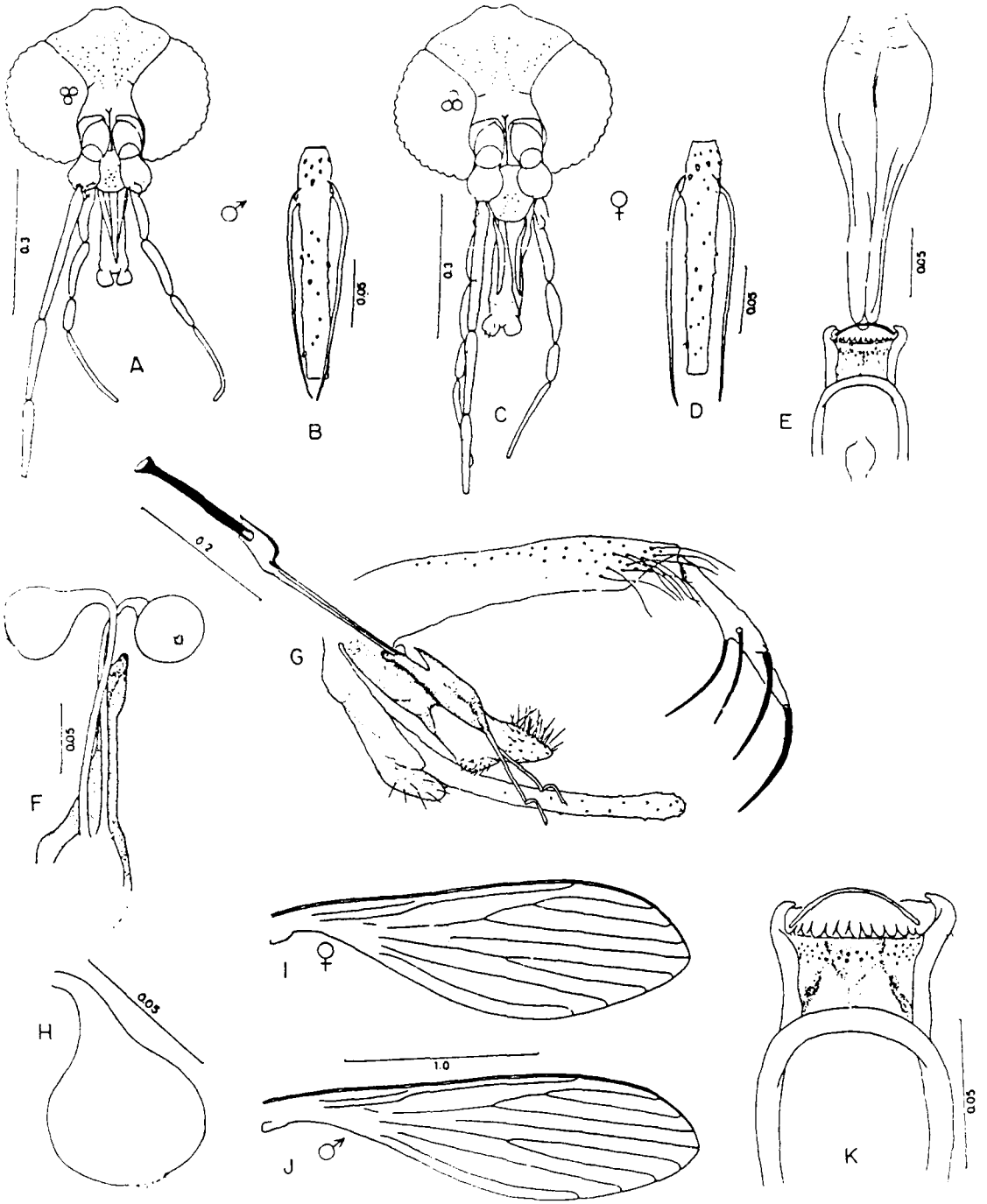



Plate 27-11

Lutzomyia aragaoi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Spermathecae; G. Male terminalia; H. Spermatheca; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

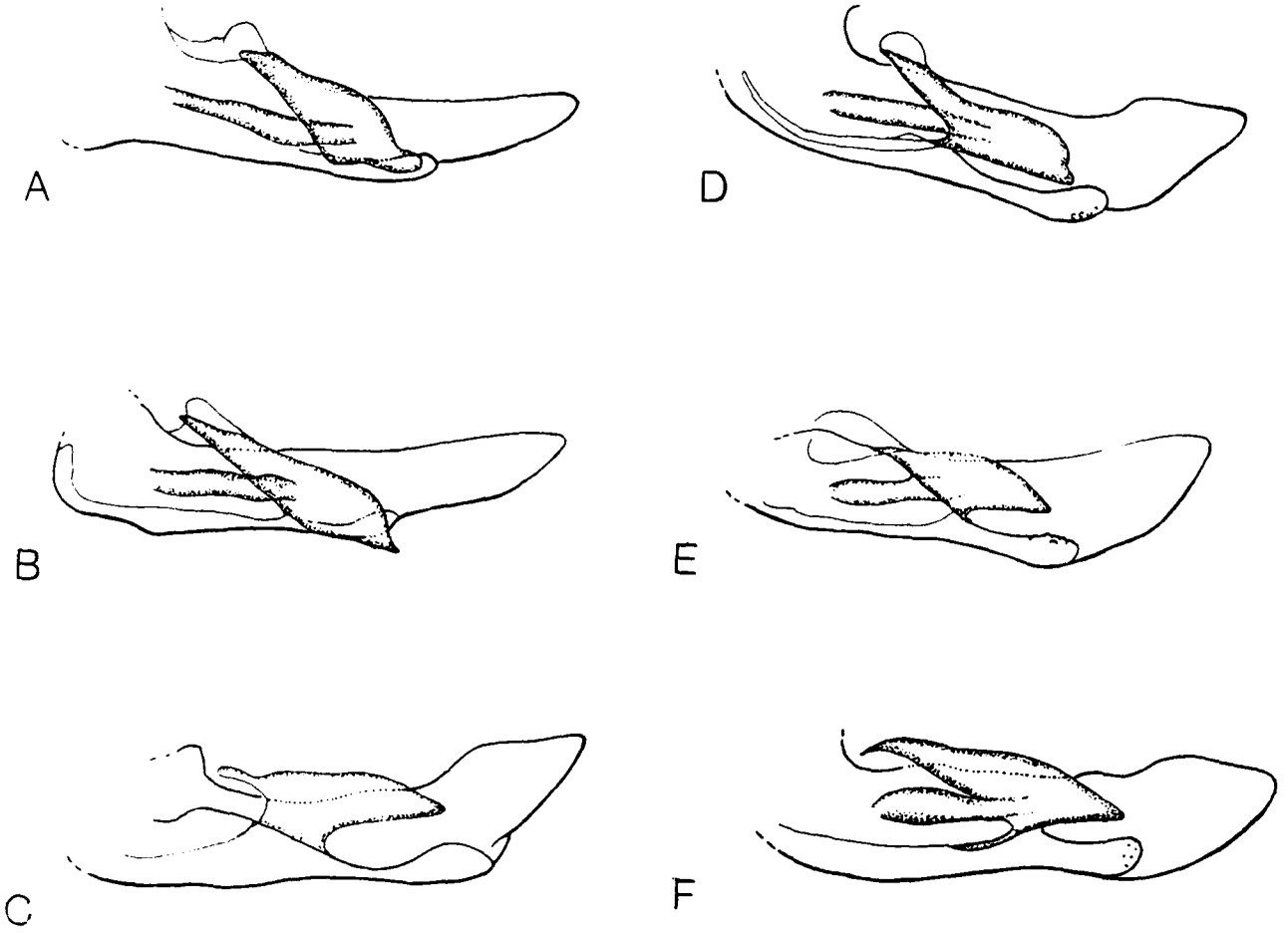
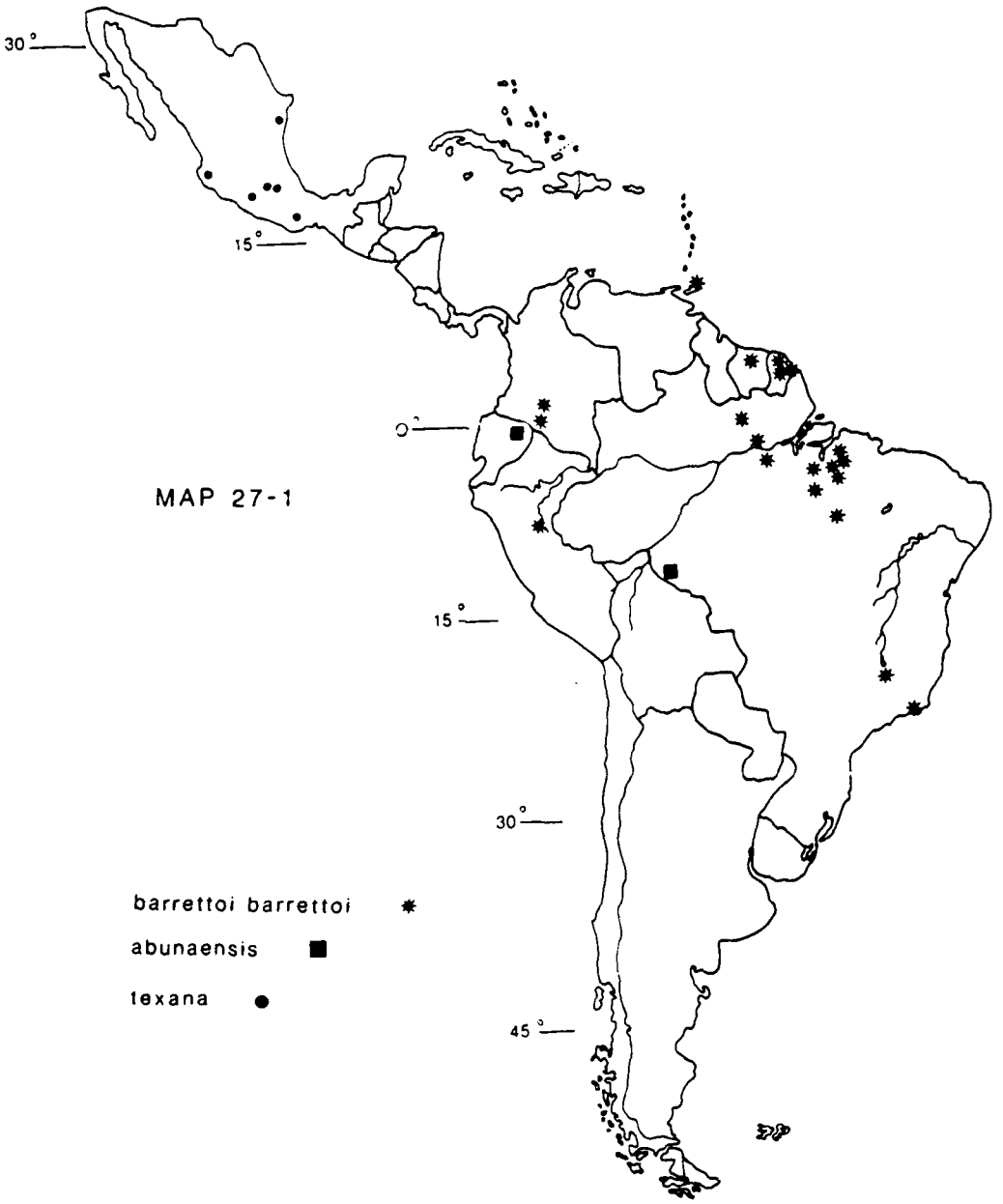
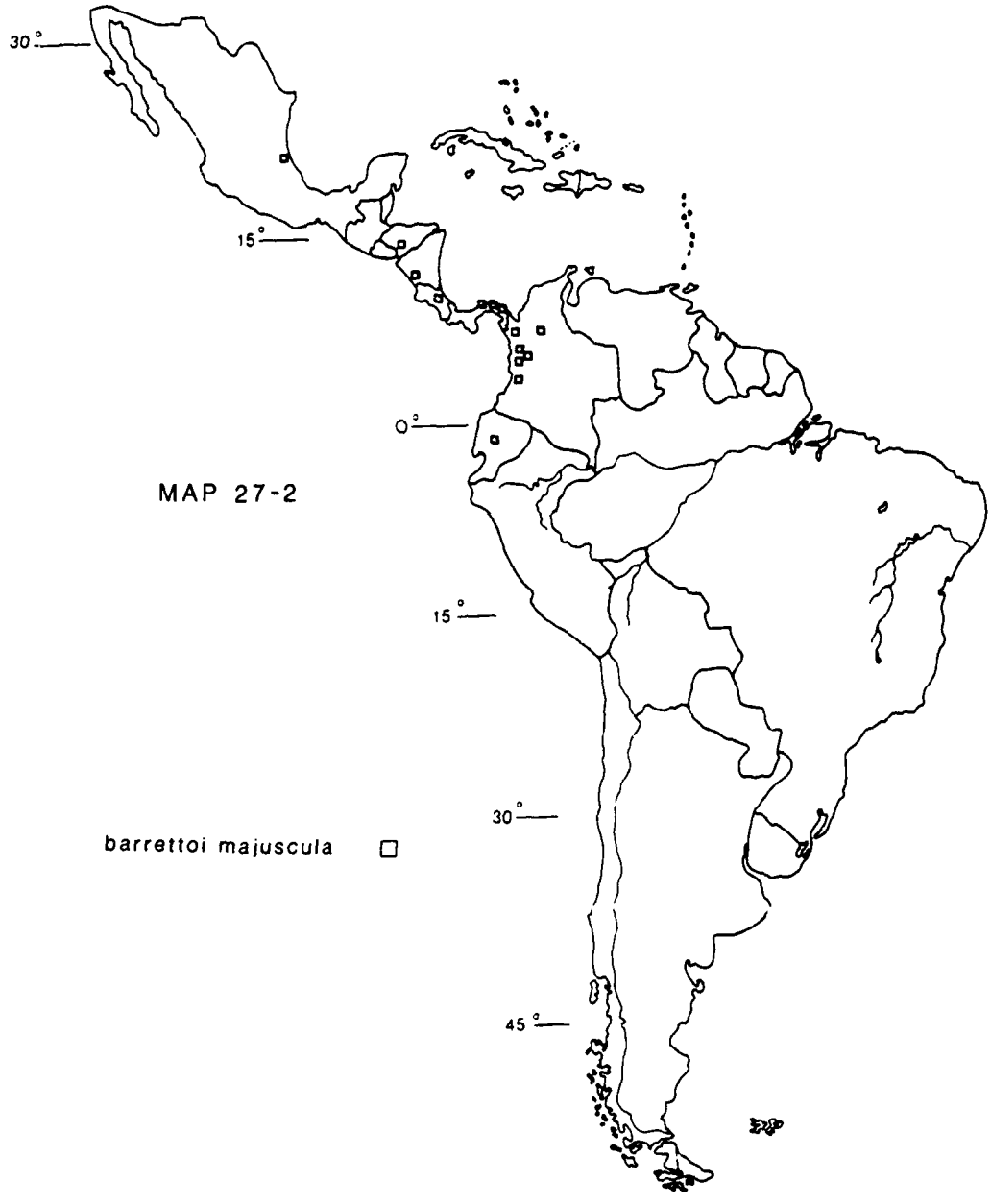



Plate 27-12

Lutzomyia aragaoi, male parameres. A. Aca Poi, San Pedro, Paraguay; B. Cruces Trail, Canal Zone, Panama; C. Rio Curiche, Choco, Colombia; D. Trinidad; E. Manaus, Amazonas, Brazil; F. Tres Esquinas, Caqueta, Colombia.




MAP 27-1



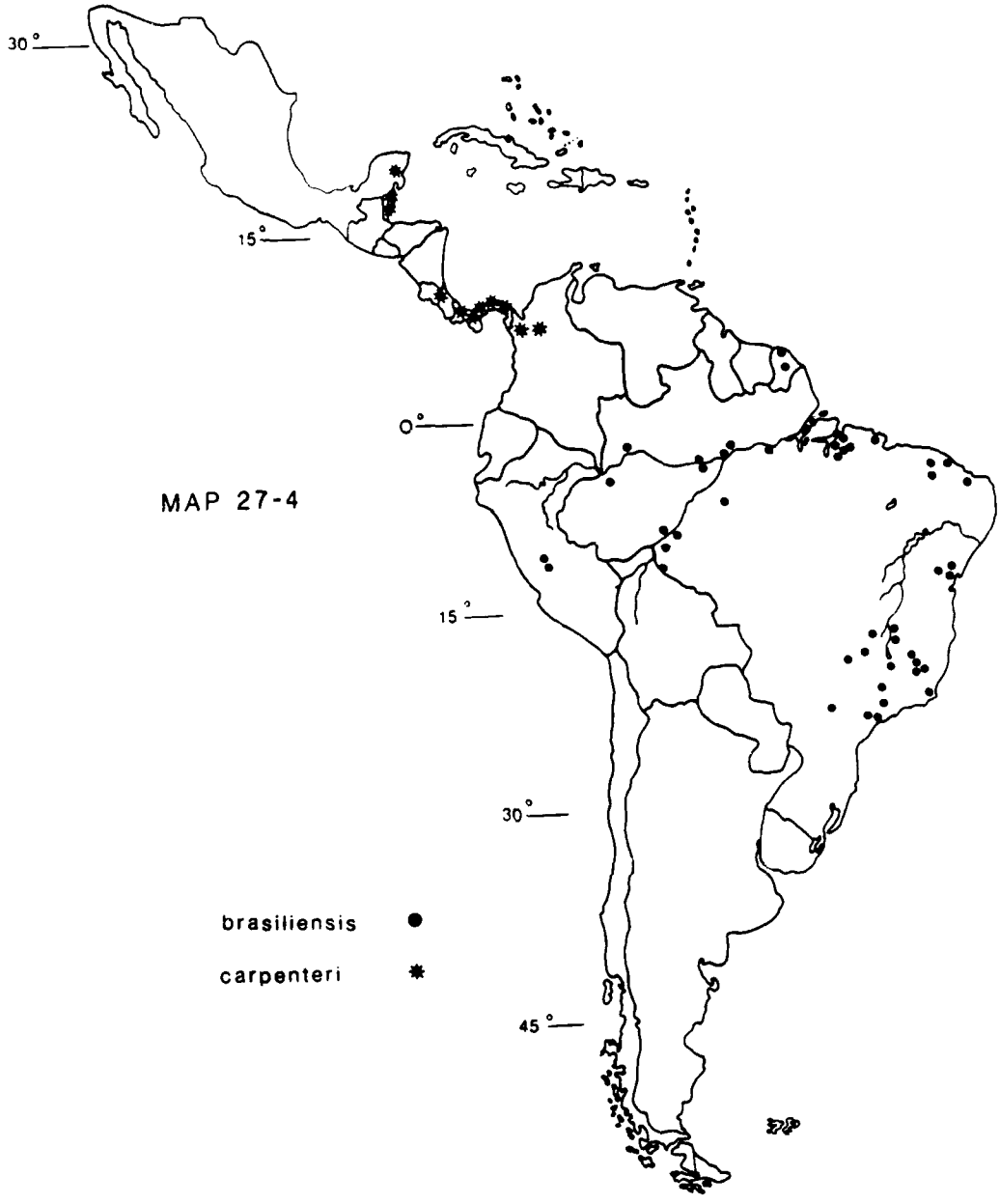

MAP 27-2

barrettoi majuscula □




MAP 27-3

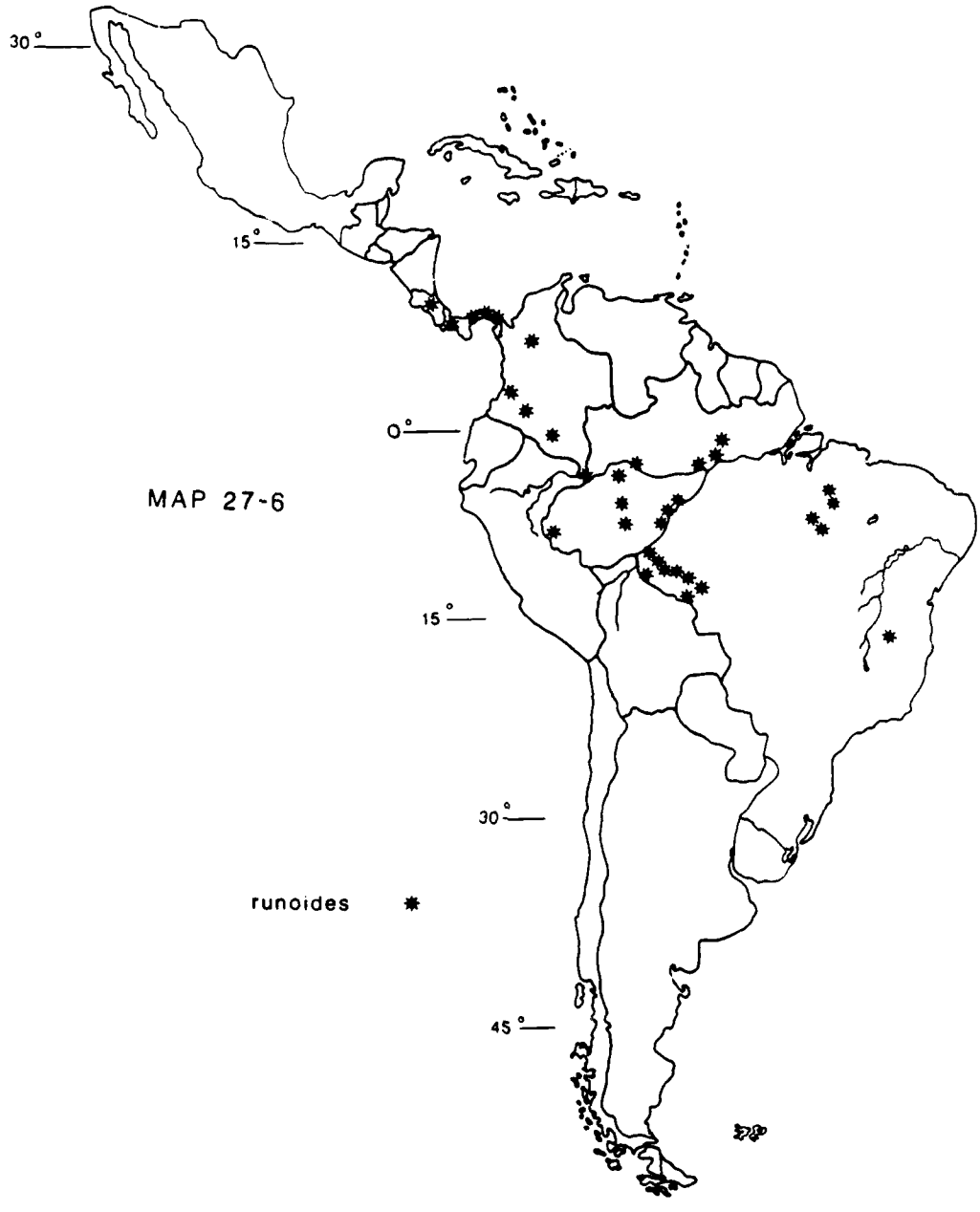
*inflata* ■




MAP 27-4




MAP 27-5




MAP 27-6

runoides




MAP 27-7

## 28. Lutzomyia Species Group Lanei

Lutzomyia species group lanei Theodor 1965: 184. Lewis et al. 1977: 325. Martins et al. 1978: 147 (defined).

Lutzomyia subgenus Trichopygomyia (in part): Forattini 1971a: 101; 1973: 292.

Identification. Coloration dusky, moderately pigmented. Antennal ascoids with short but discernible proximal spurs. Palpomere 5 relatively short, less than palp. 3 + 4. ♀ cibarium with 4 horizontal teeth, 1 or 2 rows of vertical teeth; complete arch & conspicuous pigment patch. Pharynx unarmed. Spermathecae annulated; individual ducts longer than common duct. ♂ genitalia. Coxite lacking persistent setae, strongly arched. Style with 4 spines; no subterminal seta. Paramere arched dorsally. Genital filament tips bluntly rounded & slightly sinuous.

The 3 species in this group closely resemble some of those in the subgenus Psathyromyia. The strongly arched coxite is typical of the lanei group males but this may prove to be of little importance when other character states are considered. Hanson (1968) places the larvae of L. shannoni and L. lanei together in Group 2 of his preliminary classification of New World sand flies.

We do not key the females because only that of L. lanei has been described.

Medical Importance. Unknown; the females have not been reported feeding on man.

Key to the Males of the Species Group Lanei

1. Paramere ending in a finger-like lobe. ..... 2

   Paramere otherwise. ..... L. pelloni (Pl. 28-1)

2. Paramere gently tapering towards apex; relatively slender with longitudinal row of 1st seta above ventral margin with recurved, swollen tips. ..... L. lanei (Pl. 28-2)

   Paramere taping abruptly before apex; relatively broad with <10 such setae. ..... L. digitata (Pl. 28-2)

Lutzomyia pelloni (Sherlock & Alencar)

Plate 28-1

Phlebotomus pelloni Sherlock & Alencar 1959: 119 (♂, Pocoes, Bahia, Brazil).

Lutzomyia pelloni: Theodor 1965: 185 (listed). Forattini 1971a: 102 (listed); 1973: 314 (♂ figs., tax.). Martins et al. 1978: 148 (refs., dist.). Vexenat et al. 1986b: 296 (Bahia, Brazil).

Distribution (Map 28-1). Brazil (Martins et al. 1978; Vexenat et al. 1986b).

Remarks. We have examined females of L. pelloni (Pl. 28-1). The spermathecae, cibarial armature and other structures appear to be identical to those of L. lanei described by Coutinho & Barretto (1941b) and figured also by Theodor (1965) and Martins et al. (1978). The pelloni female will be fully described in a forthcoming article.

## Lutzomyia lanei (Barretto & Coutinho)

Plate 28-2

Phlebotomus lanei Barretto & Coutinho 1941d: 185 (♂, Casa Grande, São Paulo, Brazil). Coutinho & Barretto 1941b: 76 (♀).

Lutzomyia lanei: Theodor 1965: 185 (figs.). Forattini 1971a: 102 (listed); 1973: 306 (figs., tax.). Martins et al. 1978: 147 (refs, dist.). Aguiar et al. 1985c: 467 (seasonal dist., Brazil).

Distribution (Map 28-2). Brazil (Martins et al. 1978); Paraguay (8 ♂♂, Sommerfield, Yhú, tree holes & Shannon trap, 1950, M. Hertig; 1 ♂, 1 ♀, Acá-Poi, San Pedro, same data).

Remarks. This species has not been reported previously in Paraguay. The immature stages were described and illustrated by Barretto (1941a).

Lutzomyia digitata (Damasceno & Arouck)

Plate 28-2

Flebotomus digitatum Damasceno & Arouck 1950: 465 (♂, Banco Central, Ilhéus, Bahia, Brazil).

Lutzomyia digitatum: Theodor 1965: 185 (listed).

Lutzomyia digitata: Forattini 1971a: 102 (listed); 1973: 306 (♂ fig., tax.). Martins et al. 1978: 147 (refs., dist.).

Distribution (Map 28-2). Brazil (Martins et al. 1978).

Remarks. Lutzomyia digitata is a little-known species from Bahia State, Brazil. The female is undescribed.

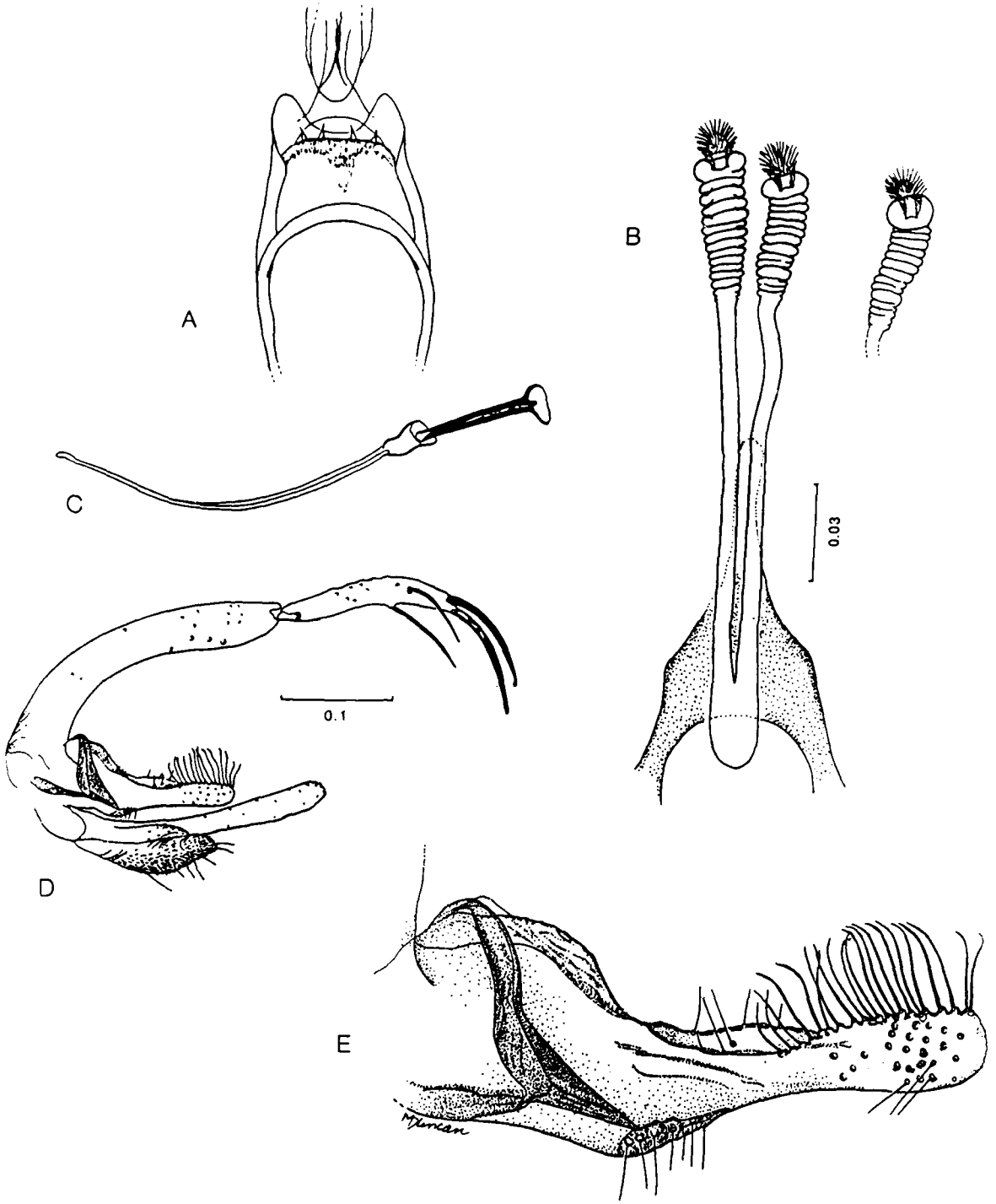



Plate 28-1

Lutzomyia pelloni. A. Female cibarium; B. Spermathecae; C. Genital pump & filaments; D. Male terminalia; E. Paramere.

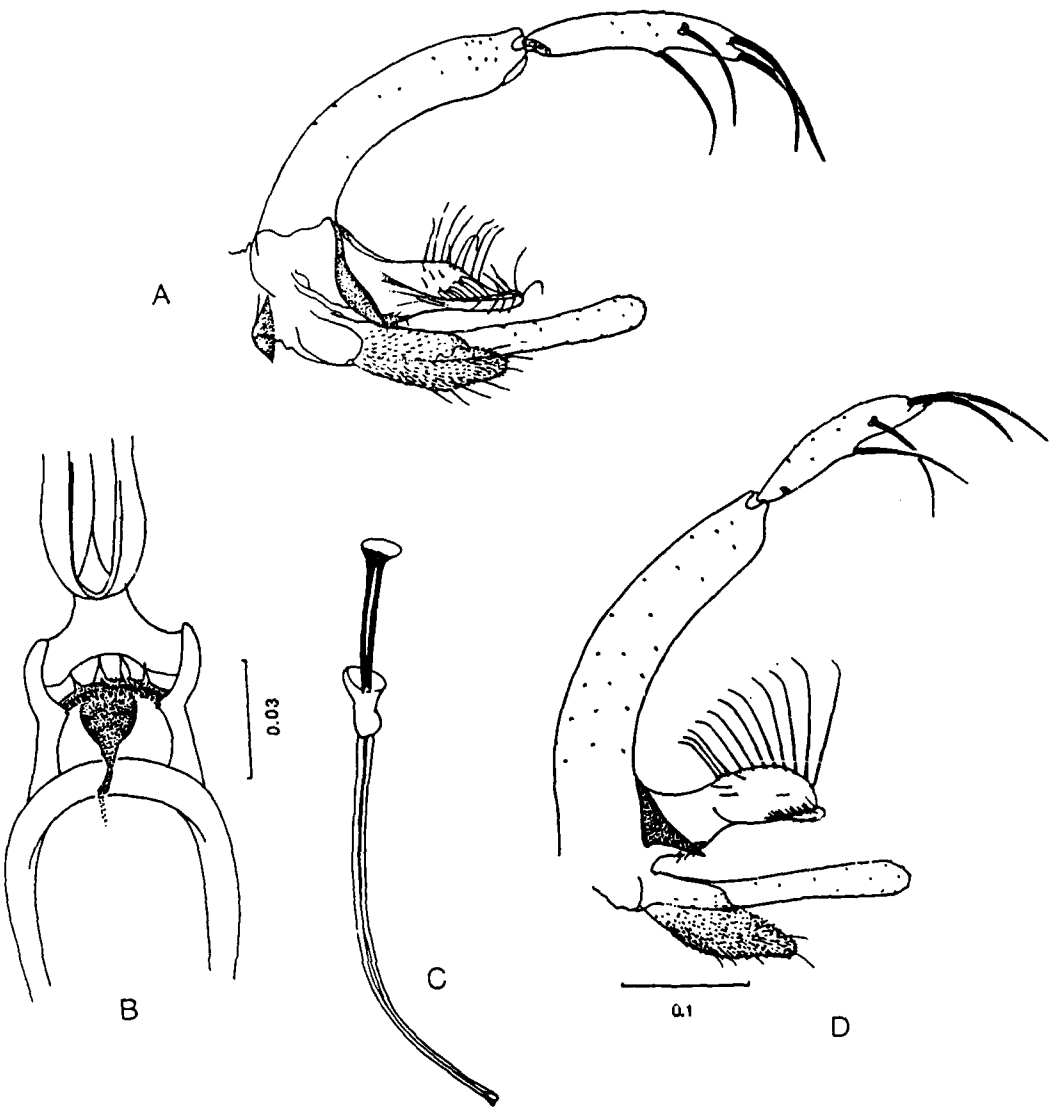



Plate 28-2

Lutzomyia lanei. A. Male terminalia; B. Female cibarium.

Lutzomyia digitata. C. Genital pump & filaments; D. Male terminalia.




MAP 28-1




MAP 28-2

## 29. Lutzomyia Species Group Dreisbachi

Lutzomyia species group dreisbachi: Lewis et al. 1977: 325. Martins et al. 1978: 152.

Identification. Coloration dusky. Antennal ascoids with long proximal spurs. Palpomere 5 shorter than palps. 3 + 4. ♀ cibarium with 10 or more horizontal teeth; a complete arch; broad pigment patch & numerous vertical teeth. Pharynx unarmed. Spermathecae strongly annulated, sometimes imbricated; terminal knob large, symmetrical or not; individual ducts relatively thin, longer than common duct. ♂ genitalia. Style with 4 large spines inserted at different levels, no subterminal seta. Coxite bearing 3-4 subapical recurved setae; other persistent setae sometimes present (L. aclydifera). Paramere variable divided or not. Lateral lobe with 7-10 heavy dorsal sets at and near its distal end.

The males in the species group dreisbachi resemble those in the baityi group in having long persistent setae near the end of each coxite but the antennal ascoids are simple, their styles have a small subterminal seta and the parameres are quite different. The spermatheca of the dreisbachi group females are similar to those of L. ignacaoi and some species in the subgenera Nyssomyia and Psathyromyia but these other sand flies have only 4 horizontal teeth in their cibaria.

Martins et al. (1978) tentatively included L. omagua in the dreisbachi group but the female, described in the present paper,

definitely belongs in the subgenus Trichophoromyia. Two other species, L. dasymera and L. campbelli, are also placed with the dreisbachi species by Martins et al. (1978) but we provisionally retain them in the subgenus Psathyromyia.

Medical Importance. Unknown. Females are not anthropophilic.

Keys to Males of the Species Group Dreisbachi

1. Coxite with 2-3 modified setae near middle. Paramere with dorsal basal hump bearing numerous thin setae & with a slender leaf-like seta at apex. ..... L. aclydifera (Pl. 29-1)

   Coxite without persistent setae near middle. Paramere bifurcate or with relatively long dorsal arm, without modified seta at apex. .... 2

2. Paramere with dorsal arm bearing setae. ..... 3

   Paramere with blade-like dorsal arm without setae. .....
   ..... L. ruparupa (Pl. 29-2)

3. Paramere with very slender, arched dorsal arm; lower arm much wider with a dorsal subterminal hump bearing some recurved setae. .....
   ..... L. hermanlenti (Pl. 29-3)

   Paramere with thicker dosal arm; lower arm more or less subequal in width throughout, without a dorsal subterminal hump or recurved setae. ..... L. dreisbachi (Pl. 29-3)

The dreisbachi group females are not keyed because they are structurally similar; however, the spermathecae of L. dreisbachi have an irregularly shaped terminal knob unlike those of L. aclydifera and L. hermanlenti. The female of L. ruparupa, not yet fully described, is similar to other females in this group.

## Lutzomyia aclydifera (Fairchild & Hertig)

Plate 29-1

Phlebotomus aclydiferus Fairchild & Hertig 1952: 511 (♂, ♀, Panama Canal Zone). Hanson 1968: 44 (larva, pupa).

Lutzomyia aclydifera: Theodor 1965: 193. Martins et al 1978: 153 (dist.). Young 1979 (full refs.). Lewis & Macfarlane 1981: 170 (mite parasite). Christensen et al. 1983: 469 (coll. data, Panama). Zeledon & Murillo 1983: 280 (Nicaragua). Young and Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledon 1985: 125 (figs., Costa Rica). Le Pont & Desjeux 1986: 314 (Bolivia).

Psychodopygus aclydiferus: Forattini 1971a: 105 (listed); 1973: 463 (figs., redescript.)

Distribution (Map 29-1). Southern Mexico to Ecuador (Young 1979); Nicaragua (Zeledon & Murillo 1983).

Remarks. This species is readily attracted to light (Young 1979) and is commonly found in mammal burrows in Panama (Christensen et al. 1983).

Le Pont & Desjeux (1986) reported L. aclydifera from Bolivia in human bait collections but these specimens (2 ♀♀) probably represent females of L. ruparupa, the males of which have been found in the same area. Hanson (1968) described and illustrated the fourth instar larva and the pupa of L. aclydifera.

## Lutzomyia dreisbachi (Causey & Damasceno)

Plate 29-3

Flebotomus dreisbachi Causey & Damasceno 1945b: 645 (♂, Brazil, Amazonas, Municip. Coari). Barretto 1947a: 197.

Phlebotomus dreisbachi: Floch & Abonnenc 1952: 85 (figs., review).

Lutzomyia dreisbachi: Theodor 1965: 185. Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 154 (dist.). Young 1979: 139. Morales & Minter 1981: 96 (Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Young et al. 1985: 143 (Peru). Ryan 1986: 27 (figs.). Lebbe et al. 1987: 28 (computer aided ident.).

Psychodopygus dreisbachi: Forattini 1971a: 105; 1973: 463 (figs., redescript.).

Distribution (Map 29-1). Colombia (Young 1979; Morales & Minter 1981); Brazil (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); Peru (Young et al. 1986); French Guiana (Floch & Abonnenc 1952; Leger et al. 1977).

Remarks. The habits of L. dreisbachi are little-known. Specimens have been collected in armadillo burrows in Brazil (Causey & Damasceno 1945b; Ryan 1986) and in light and flight traps. The asymmetrical terminal knob of the spermatheca (Pl. 29-3) of a Peruvian female may not be as marked in females from other localities but was observed in two females from Manaus, Amazonas, Brazil.

Lutzomyia hermanlenti Martins, Silva & Falcao

Plate 29-3

Lutzomyia hermanlenti Martins, Silva & Falcao 1970a: 547 (♂♀, Brazil, Minas Gerais, Municip. Arinos). Martins et al 1978: 155 (dist.).

Psychodopygus hermanlenti: Forattini 1973: 468.

Distribution (Map 29-1). Brazil (Martins et al. 1978).

Lutzomyia ruparupa Martins, Llanos & Silva

Plate 29-2

Lutzomyia ruparupa Martins, Llanos & Silva 1976a: 491 (♂, Peru, Huanuco Dept., Cachicoto)

Distribution (Map 29-1). Peru (Martins et al. 1976a; ♂♂, ♀♀, Pasco Dept., Puzuzo, E. Perez); Bolivia (♂, La Paz Dept., Serrania de Marimonos, F. Le Pont).

Remarks. The L. ruparupa female will be fully described by E. Perez in a forthcoming publication dealing with Peruvian phlebotomines.

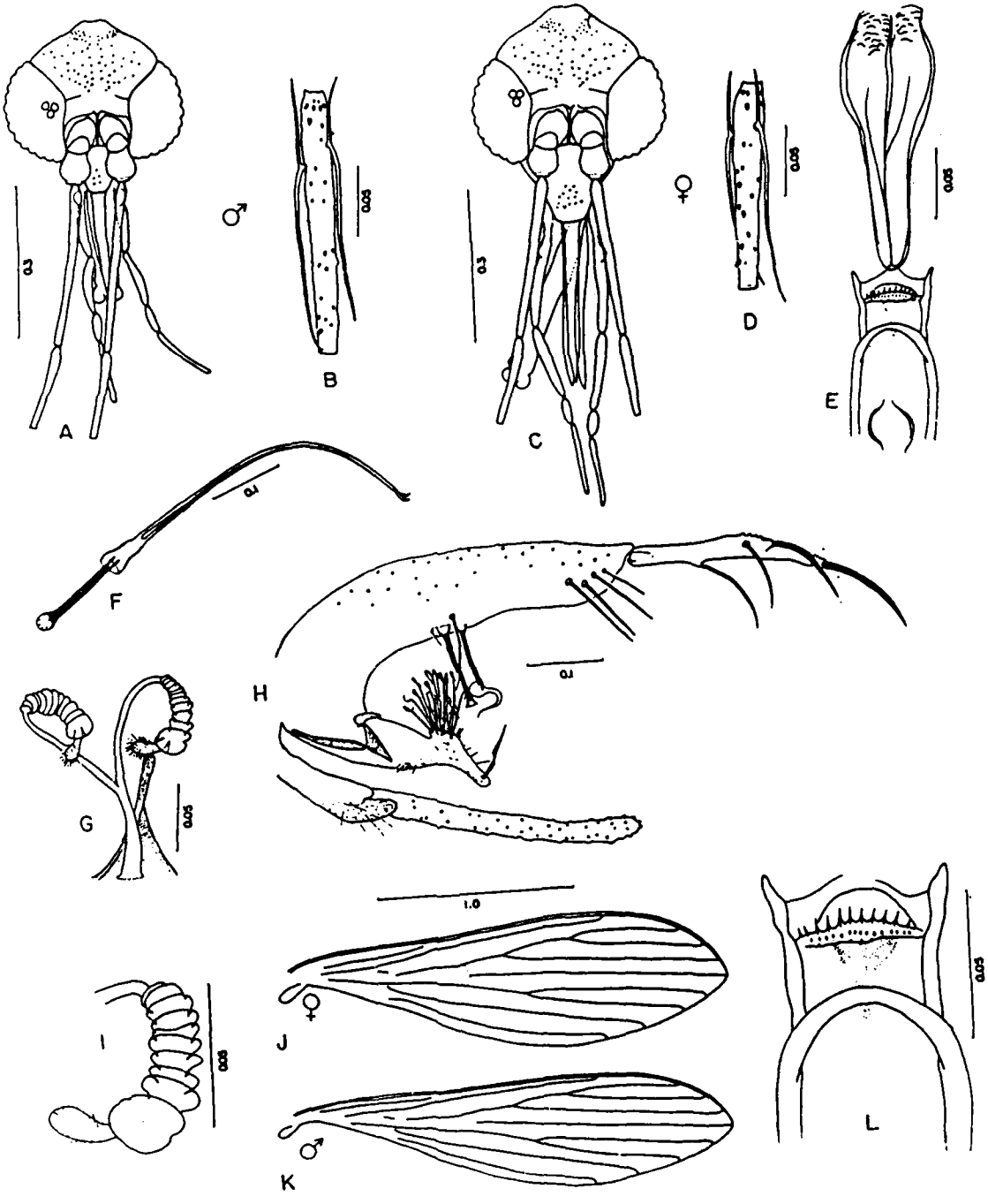



Plate 29-1

Lutzomyia aclydifera. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Spermathecae; H. Male genitalia; I. Body of spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

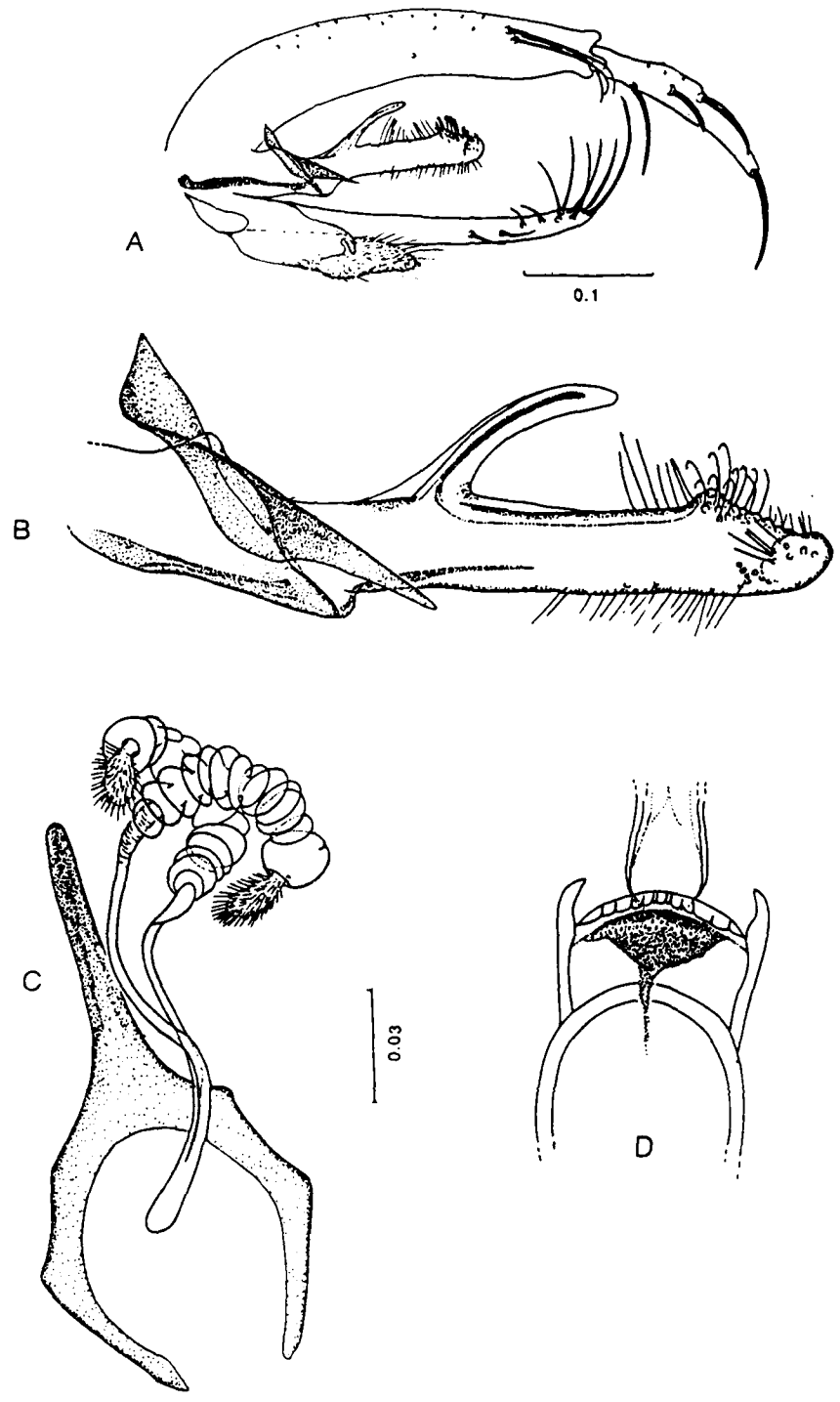



Plate 29-2

Lutzomyia ruparupa. A. Male terminalia, B. Paramere & aedeagus, C. Spermathecae, D. Female cibarium.

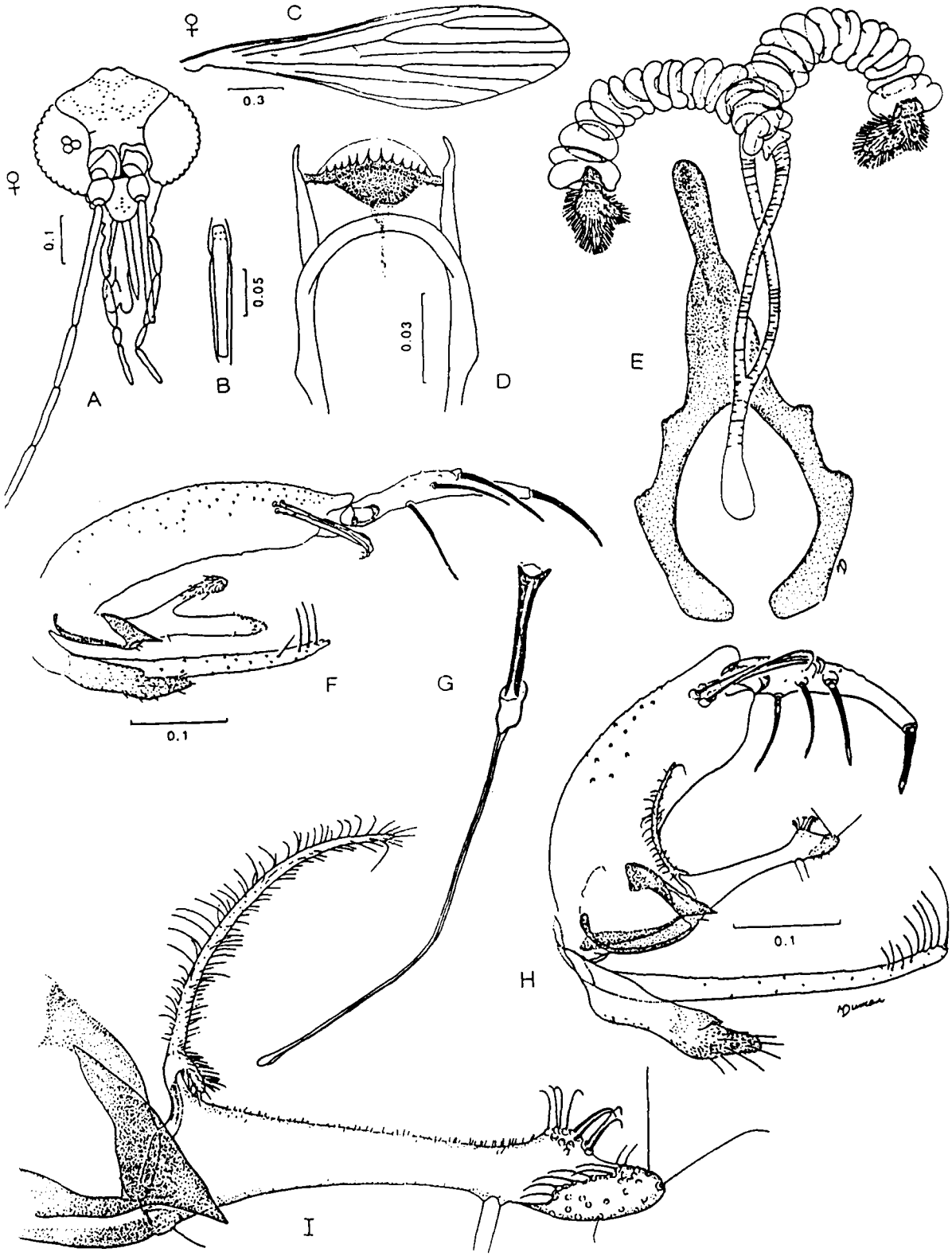
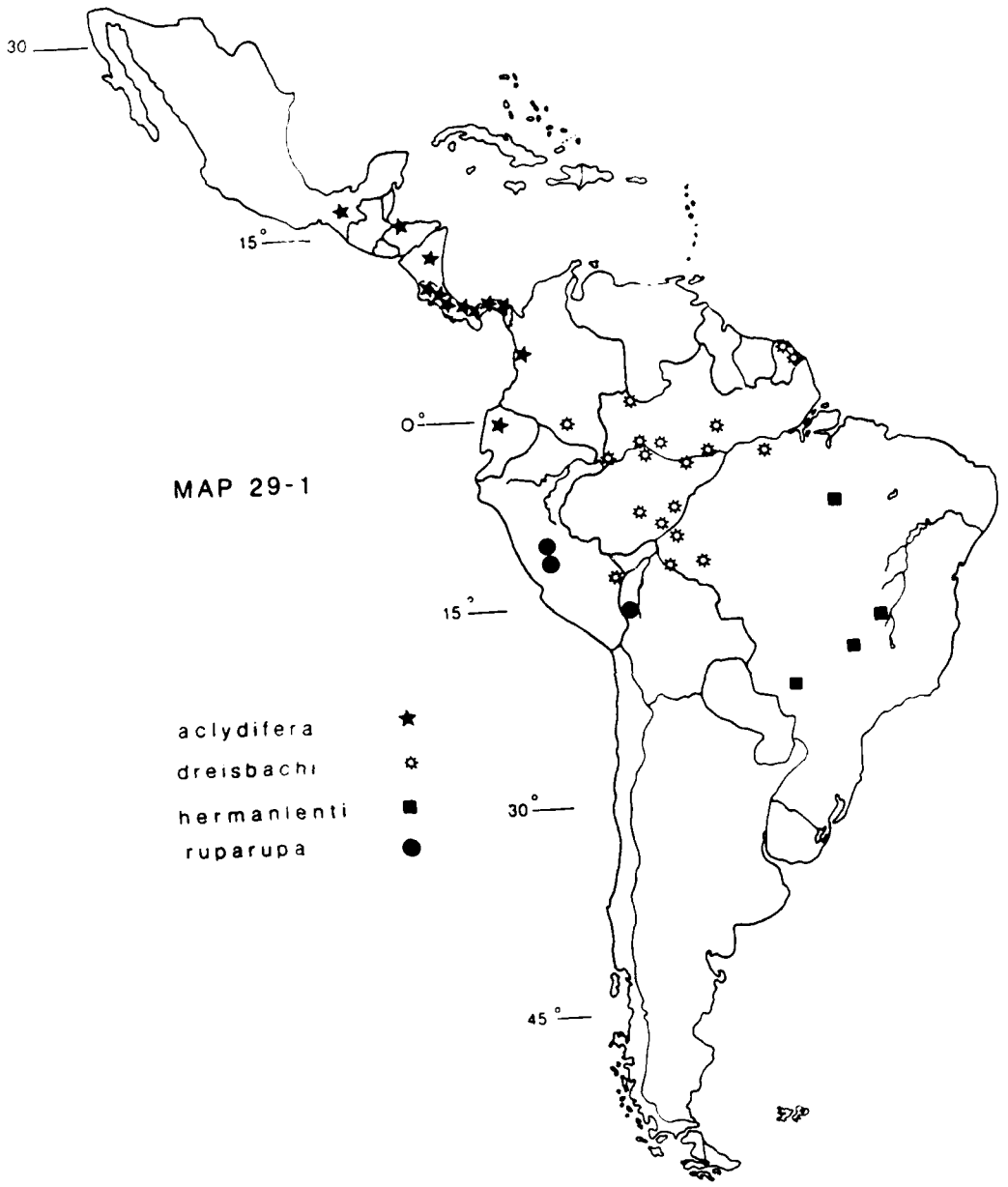



Plate 29-3

Lutzomyia dreisbachi. A. Female head. B. Flagellomere II showing posterior spurs on ascoids. C. Female wing. D. Female cibarium. E. Spermathecae. F. Male terminalia.

Lutzomyia hermanlenti. G. Genital pump & filaments. H. Male terminalia. I. Aedeagus & paramere, enlarged.


30
15°
0°
15°
30°
45°
aclydifera
dreisbachi
hermanienti
ruparupa

MAP 29-1

## 30. Lutzomyia Subgenus Trichopygomyia Barretto

Lutzomyia subgenus Trichopygomyia Barretto 1962: 98 (type species: Flebotomus longispinus Mangabeira by orig. designation). Forattini 1971a: 102 (in part); 1973: 292. Martins et al. 1978: 112 (defined). Arias et al. 1983 (defined, review, figs.).

Lutzomyia species group longispina Theodor 1965: 189. Lewis et al. 1977: 325 (listed).

Identification. Coloration dusky. Antennal ascoids simple, reaching to (or beyond) distal fourth of flagellomere II. Palpomere 5 longer than palps. 2 + 3. ♀ cibarium with 4 equidistant horizontal teeth, 1 or 2 rows of vertical teeth; arch complete or nearly complete; pigment patch subtriangular, conspicuous. Spermatheca subspherical or pear-shaped with fine transverse striations; individual ducts longer than common duct, smooth-walled or convuluted. ♂ genitalia. Coxite without setal tuft but with numerous long ventral setae. Style with 4 large spines inserted at different levels & subterminal seta. Paramere bifurcate or trifurcate.

Forattini (1971a; 1973) expands this subgenus by adding a number of species that we and others place in other subgenera and species groups. The females are difficult to identify with certainty but Arias et al. (1983) provide a key to some of the species.

Most Lutzomyia (Trichopygomyia) spp. are readily attracted to light and are also commonly found resting in armadillo burrows.

Medical Importance. Unknown; females are not anthropophilic.

Key to the Males of the Subgenus Trichopygomyia

1. Paramere trifurcate. ..... 2
   Paramere bifurcate. ..... 5

2. Paramere with arched dorsal arm bearing 10 or more foliaceous apical setae. ..... L. elegans (Pl. 30-1)
   Paramere with dorsal arm bearing slender apical setae. ..... 3

3. Aedeagus very broad, nearly as wide as long; dorsal margin markedly humped. Paramere with dorsal arm directed anteriorally, not curved & with relatively short setae. ..... L. martinezi (Pl. 30-2)
   Aedeagus much longer than wide. Paramere with arched dorsal arm directed posteriorally & bearing numerous long setae at apex. ..... 4

4. Paramere with median arm nearly as long as lower arm & bearing setae; dorsal arm with straight apical setae. ..... L. triramula (Pl. 30-3)
   Paramere with median arm without setae & reduced to a cylindrical lobe, much shorter than lower arm. ..... L. gantieri (Pl. 30-4)

5. Aedeagus modified with dorsal extension. ..... 6

Aedeagus simple without dorsal extension. ..... 8

6. Paramere with long dorsal arm, reaching to or beyond end of lower arm. Aedeagus as shown. ..... L. conviti (Pl. 30-5)

Paramere with shorter dorsal arm ending well before end of lower arm. Aedeagus otherwise. ..... 7

7. Aedeagus with dorsal extension clubbed, its maximum width greater than that of paramere. ..... L. dasypodogeton (Pl. 30-6)

Aedeagus with unclubbed dorsal extension, its maximum width subequal to width of paramere beyond dorsal arm. .....

..... Lutzomyia (Trichopygomyia) n.sp. #1 (Pl. 30-7)

8. Paramere with long & slender dorsal arm, its width less than ½ width of lower arm. ..... L. trichopyga (Pl. 30-8)

Paramere with broader dorsal arm, its width greater than ½ width of lower arm. ..... 9

9. Paramere wrench-shaped. ..... L. rondoniensis (Pl. 30-9)

Paramere otherwise. ..... 10

10. Paramere with ventral arm extending well beyond end of dorsal arm.

..... L. witoto (Pl. 30-10)

Paramere otherwise, its ventral arm ending before, at, or but slightly beyond dorsal arm. ..... 11

11. Paramere with dorsal arm or lobe at least twice as large as reduced ventral arm. ..... L. ferroae (Pl. 30-11)

Paramere with dorsal arm less than twice the width of ventral arm.... 12

12. Paramere with dorsal arm tubular at apex & bearing few small setae. ..... L. ratcliffei (Pl. 30-12)

Paramere with dorsal arm otherwise. ..... 13

13. Paramere with dorsal arm larger than ventral arm. ..... ..... L. wagleyi (Pl. 30-13)

Paramere with dorsal arm smaller than ventral arm. ..... ..... L. longispina (Pl. 30-14)

Lutzomyia (Trichopygomyia) elegans Martins, Falcao & Silva

Plate 30-1

Lutzomyia elegans Martins, Llanos & Silva 1976a: 488 (♂, ♀, Cachicoto, Huanuco, Peru). Martins et al. 1978: 114; 1983b: 229 (keyed). Arias et al. 1983: 453 (♂, ♀ figs., refs.).

Distribution (Map 30-1). Peru (Martins et al. 1976a).

Lutzomyia (Trichopygomyia) martinezi Young & Morales

Plate 30-2

Lutzomyia martinezi Young & Morales 1987: 653 (♂, ♀, Rio Iteviare, Meta, Colombia).

Distribution (Map 30-2). Colombia (type locality).

Lutzomyia (Trichopygomyia) triramula (Fairchild & Hertig)

Plate 30-3

Phlebotomus triramulus Fairchild & Hertig 1952: 517 (♂, ♀, Medio, Colon, Panama).

Lutzomyia triramula (or triramulus). Barretto 1962: 98 (listed). Forattini 1973: 321 (♂, ♀, figs., tax.). Martins et al. 1978: 114 (refs., dist.). Young 1979: 123 (♂, ♀, figs., refs.). Porter & De Foliart 1981: 158 (listed). Martins et al. 1983b: 229 (keyed). Arias et al. 1983: 463 (keyed, figs.). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 102 (♂, ♀, figs., Costa Rica).

Distribution (Map 30-1). Guatemala (1 ♂, 1 ♀, 12 km S. of Toquelá, Izabal, light trap, February 1981, C.H. Porter); Belize (Martins et al. 1978); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979).

Remarks. The cerci of L. triramula, with the nipple-like ends, are characteristic of this species except for females occurring near Buenaventura, Colombia (see Pl. 30-3).

Lutzomyia (Trichopygomyia) gantieri Le Pont & Desjeux

Plate 30-4

Lotzomyia gantieri Le Pont & Desjeux 1987c: 571 (♂, ♀, Serrania de Marimonos, Alto Beni, Bolivia).

Distribution (Map 30-1). Bolivia (type locality).

Remarks. The male of L. gantieri differs from L. elegans in the shape and setation of the parameres. The setae at the end of the dorsal arm are simple, not spatulate, and the median lobe is larger than that of L. elegans.

Lutzomyia (Trichopygomyia) conviti Ramirez Perez, Martins & Perez

Plate 30-5

Lutzomyia conviti Ramirez Perez, Martins & Perez 1976: 599 (♂, ♀, Amazonas, Venezuela). Feliciangeli 1980: 254 (keyed). Martins et al. 1983b: 229 (♂, keyed). Arias et al 1983: 451 (♂ figs., keyed). Young & Morales 1987: 664 (♂, Meta, Colombia).

Distribution (Map 30-3). Venezuela (Ramirez Perez et al. 1976); Colombia (Young & Morales 1987).

Remarks. Arias et al. (1983) suggested that L. conviti and L. rondonensis may be conspecific but the modified aedeagus of the conviti male differs markedly from that of the latter species.

Lutzomyia (Trichopygomyia) dasypodogeton (Castro)

Plate 30-6

Flebotomus dasypodogeton Castro 1939: 4 (♂, Belém, Pará, Brazil). Barretto 1947a: 196 (refs.).

Lutzomyia dasypodogeton (or dasipodogeton): Barretto 1962: 98 (listed). Forattini 1973: 303 (♂ fig.). Lewis 1975a: 503 (mouthpart morphol.). Martins et al. 1978: 114 (refs., dist.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Martins et al. 1983b: 223 (♂, ♀ figs., tax., dist.). Arias et al. 1983: 451 (figs., refs., dist.). Ryan 1986: 39 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (natural flagellate infections, Brazil).

Distribution (Map 30-4). Brazil (Martins et al. 1983b; Arias et al. 1983; Ryan 1986); Bolivia (1 ♂, Beni, Guayaramerin, J. Velasco).

Remarks. Martins et al (1983b) discussed the obscure original description of this species, noting that the spelling of the specific name was dasypodogeton and not dasipodogeton of various authors (unjustified emendation).

The male is easily recognized by the bulbous dorsal extension of the aedeagus.

Lutzomyia (Trichopygomyia) n.sp. #1

Plate 30-7

Distribution (Map 30-2). Venezuela (♂, ♀, Waramasen and Jaspe, Bolivar, 12-13 July 1985, D. Feliciangeli).

Remarks. Dora Feliciangeli will describe & name this species in 1988. The male aedeagus resembles that of L. dasypodogeton but it is less clubbed & more slender.

Lutzomyia (Trichopygomyia) trichopyga (Floch & Abonnenc)

Plate 30-8

Phlebotomus trichopygus Floch & Abonnenc 1945d: 2 (♂, ♀, Crique Anguille, French Guiana; 1952: 92.

Lutzomyia trichopyga: Barretto 1962: 98 (listed). Forattini 1973: 320 (♂, ♀ figs., tax. ). Lewis 1975a: 33 (mouthpart morphol.). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 113 (refs., dist.); 1983b: 229 (keyed). Arias et al. 1983: 462 (refs., ♂, ♀ figs.). Ready et al. 1983: 780 (Pará, Brazil). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 33 (armadillo burrows, Pará, Brazil). Ryan 1986: 42 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 30-6). Suriname (Hudson & Young 1985); French Guiana (Leger et al. 1977; Martins et al. 1978); Brazil (Martins et al. 1978; 1983b; Arias et al. 1983; Ryan 1986).

Lutzomyia (Trichopygomyia) rondonensis Martins, Falcao & Silva

Plate 30-9

Lutzomyia rondonensis Martins, Falcao & Silva 1965: 12 (♂, Abuna, Rondonia, Brazil). Forattini 1973: 318 (♂ fig., tax.). Martins et al. 1978: 114 (ref.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Martins et al. 1983b: 230 (♂ keyed). Arias et al. 1983: 460 (♂ fig., keyed, dist.).

Distribution (Map 30-5). Brazil (Martins et al. 1978; Arias et al. 1983; 3 ♂♂, Itiatuba, Pará, light trap, Sept. 1972, D. Young).

Lutzomyia (Trichopygomyia) witoto Young & Morales

Plate 30-10

Lutzomyia witoto Young & Morales 1987: 655 (♂, Leticia, Amazonas, Colombia).

Distribution (Map 30-2). Colombia (type locality).

Lutzomyia (Trichopygomyia) ferroae Young & Morales

Plate 30-11

Lutzomyia ferroae Young & Morales 1987: 651 (♂, ♀, near Arboledas, Norte de Santander, Colombia).

Lutzomyia (Trichophoromyia) sp.: Young et al. 1987: 558 (negative for flagellates, Colombia).

Distribution (Map 30-5). Colombia (Young & Morales 1987 & ♂♂, ♀♀, Durania, Norte de Santander, rock crevices, 1987, J.B. Alexander & C. Ferro).

Lutzomyia (Trichopygomyia) ratcliffei Arias, Ready & Freitas

Plate 30-12

Lutzomyia ratcliffei Arias, Ready & Frietas 1983: 456 (♂, Manaus, Amazonas, Brazil).

Distribution (Map 30-3). Brazil (Arias et al. 1983).

Remarks. The males of L. ratcliffei and L. longispina are structurally similar but the shape of the parameres serves to distinguish the taxa.

Lutzomyia (Trichopygomyia) wagleyi (Causey & Damasceno)

Plate 30-13

Flebotomus wagleyi Causey & Damasceno 1945a: 25 (♂, Sao Paulo de Olivenca, Amazonas, Brazil).

Lutzomyia wagleyi: Barretto 1962: 98 (listed). Forattini 1973: 325 (♂ fig., tax.). Martins et al 1978: 115. Morales & Minter 1981: 101 (♀). Arias et al. 1983: 466 (refs., ♂, ♀ figs., dist.). Martins et al. 1983b: 230 (keyed).

Distribution (Map 30-3). Brazil (Arias et al. 1983); Colombia (Morales & Minter 1981).

## Lutzomyia (Trichopygomyia) longispina (Mangabeira)

Plate 30-14

Flebotomus longispinus Mangabeira 1942a: 186 (♂, Aurá, Pará, Belém); 1942d: 251 (♀, immatures).

Lutzomyia longispina: Barretto 1962: 98 (listed). Theodor 1965: 189 (♂, ♀ figs.). Forattini 1973: 309 (♂, ♀ figs., tax.). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 114 (refs., dist. ♂ figs.). Young 1979: 121 (refs., figs.). Feliciangeli 1980: 253 (keyed). Biancardi et al. 1982: 168 (Rondonia, Brazil). Martins et al. 1983b: 229 (keyed). Arias et al. 1983: 456 (refs., figs.); 1985: 1101 (negative for flagellates, Brazil). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 30-1). French Guiana (Leger et al. 1977); Colombia (Osorno et al. 1972b); Brazil (Arias et al. 1983); Venezuela (Pifano & Ortiz 1952).

Remarks. The records of L. longispina in Venezuela, Colombia and French Guiana were based on females and therefore require confirmation when males become available.

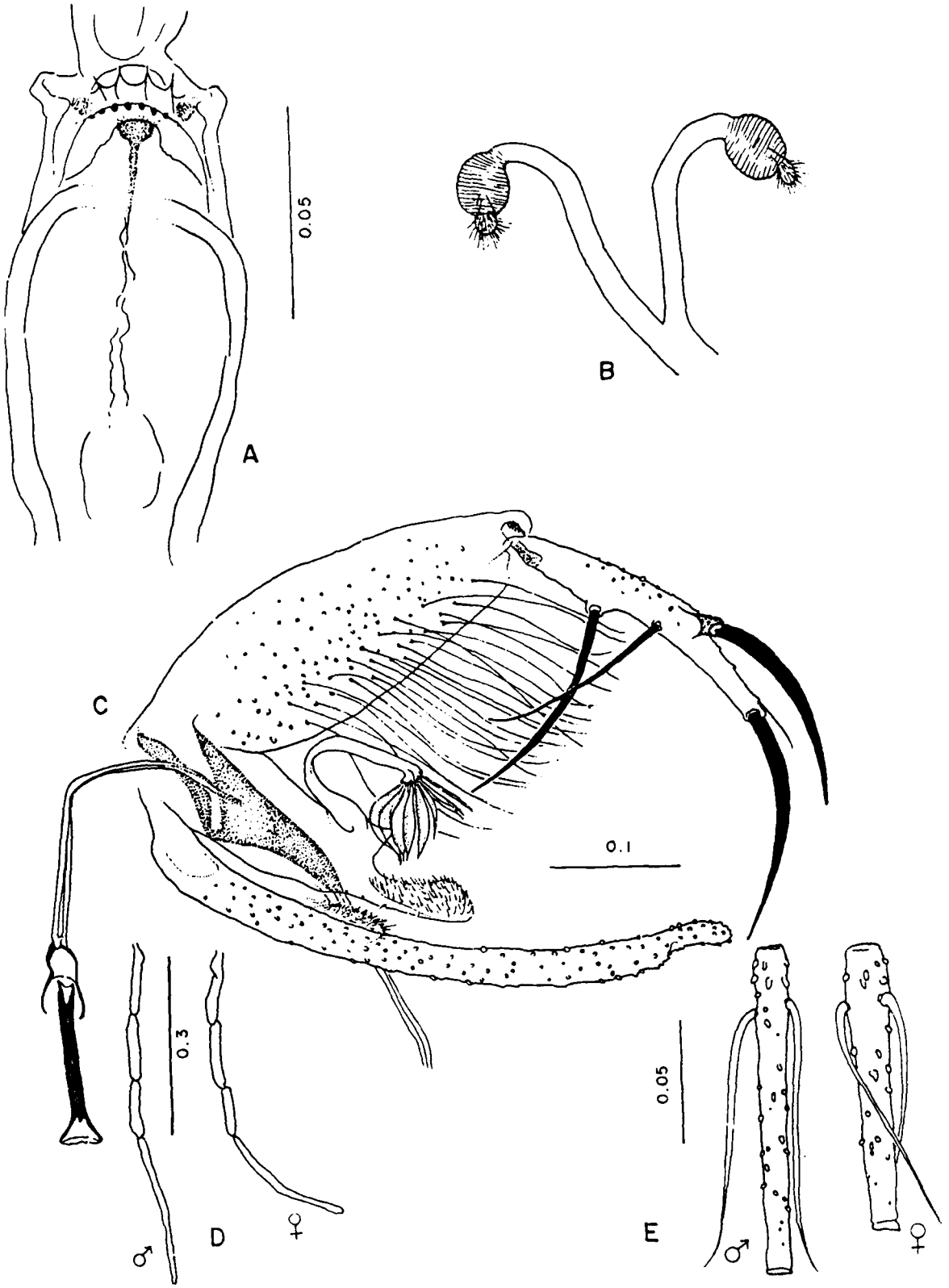



Plate 30-1

Lutzomyia elegans. A. Female cibarium; B. Spermathecae; C. Male terminalia; D. Male & female palps.; E. Male & female flagellomeres (figs. from Arias et al. 1983).

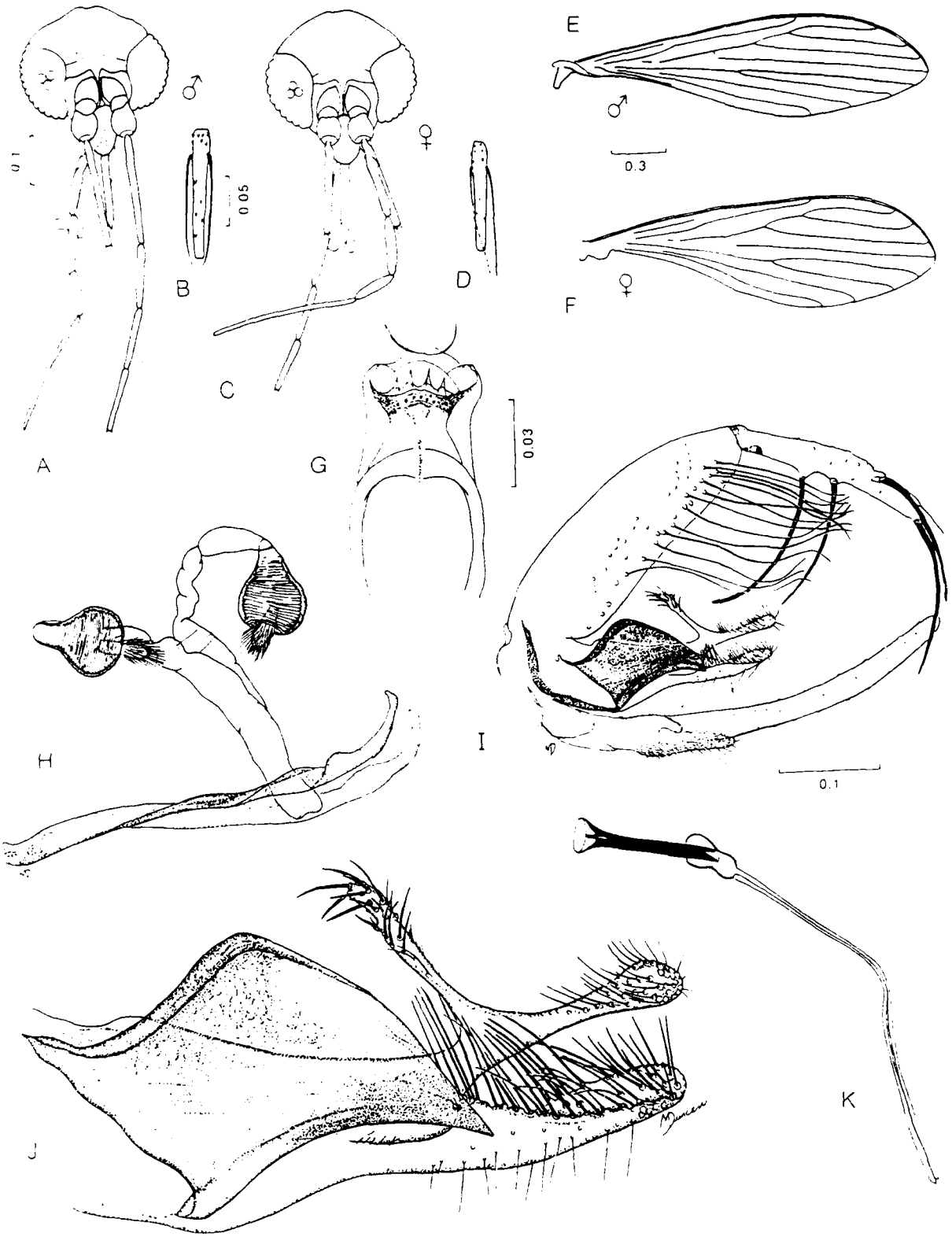



Plate 30-2

Lutzomyia martinezi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Male wing; F. Female wing; G. Female cibarium; H. Spermathecae; I. Male terminalia; J. Paramere & aedeagus; K. Genital pump & filaments (figs. after Young & Morales 1987).

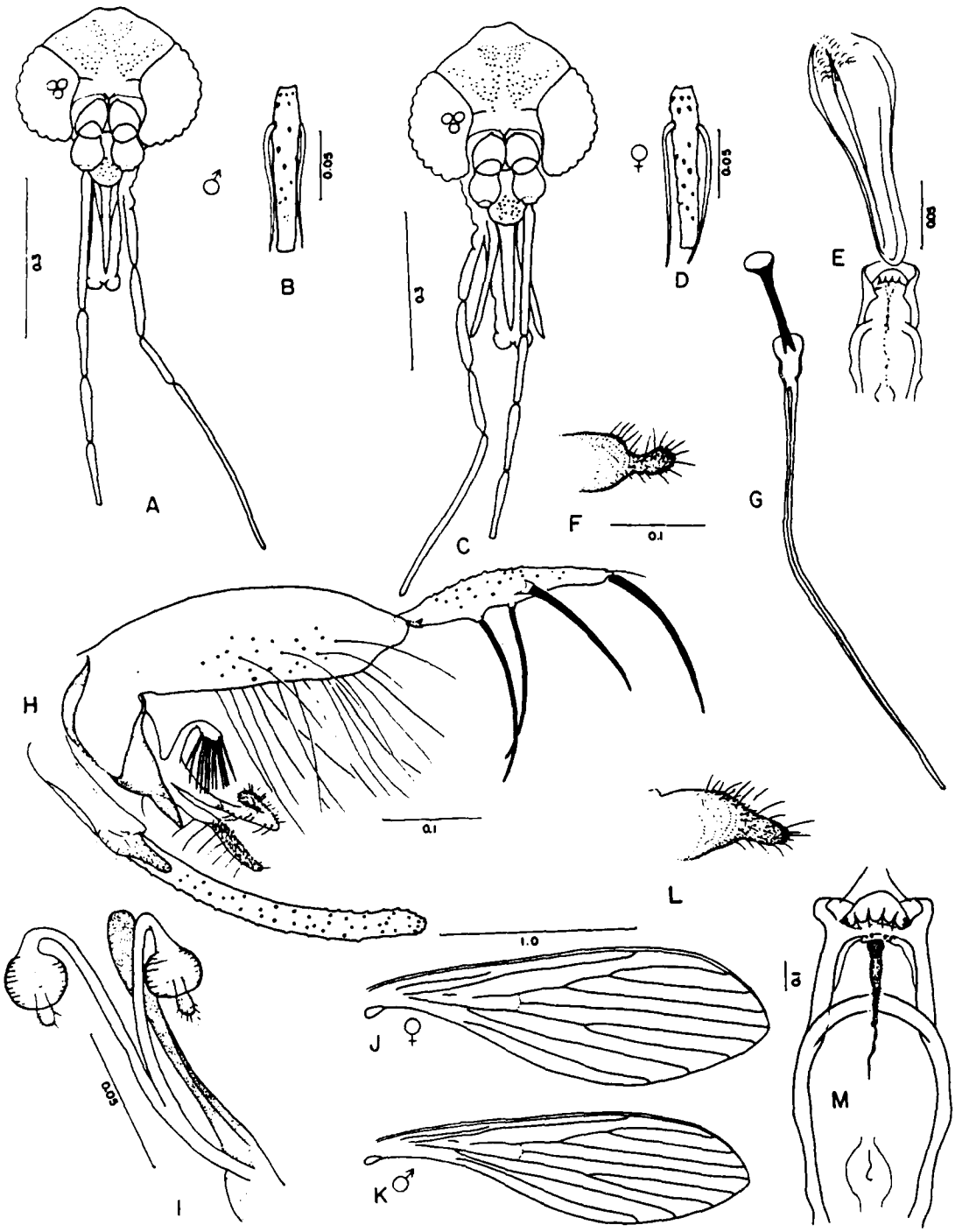



Plate 30-3

Lutzomyia triramula. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Female cercus; G. Genital pump & filaments; H. Male genitalia; I. Spermathecae; J. Female wing; K. Male wing; L. Female cercus, specimens from Valle Dept., Colombia; M. Female cibarium (from Young 1979).

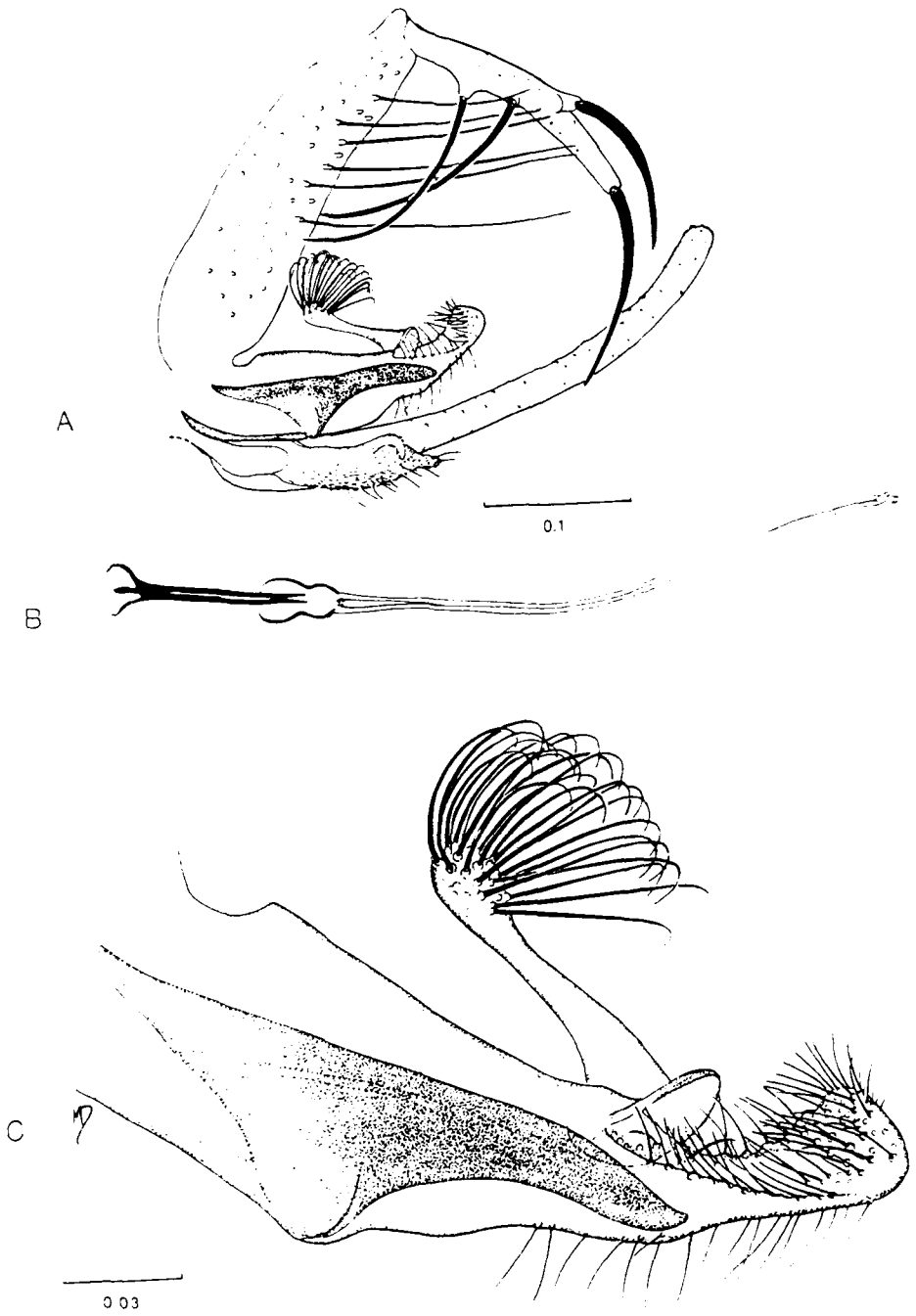



Plate 30-4

Lutzomyia gantieri. A. Male terminalia; B. Genital pump & filaments; C. Paramere & adeeagus.

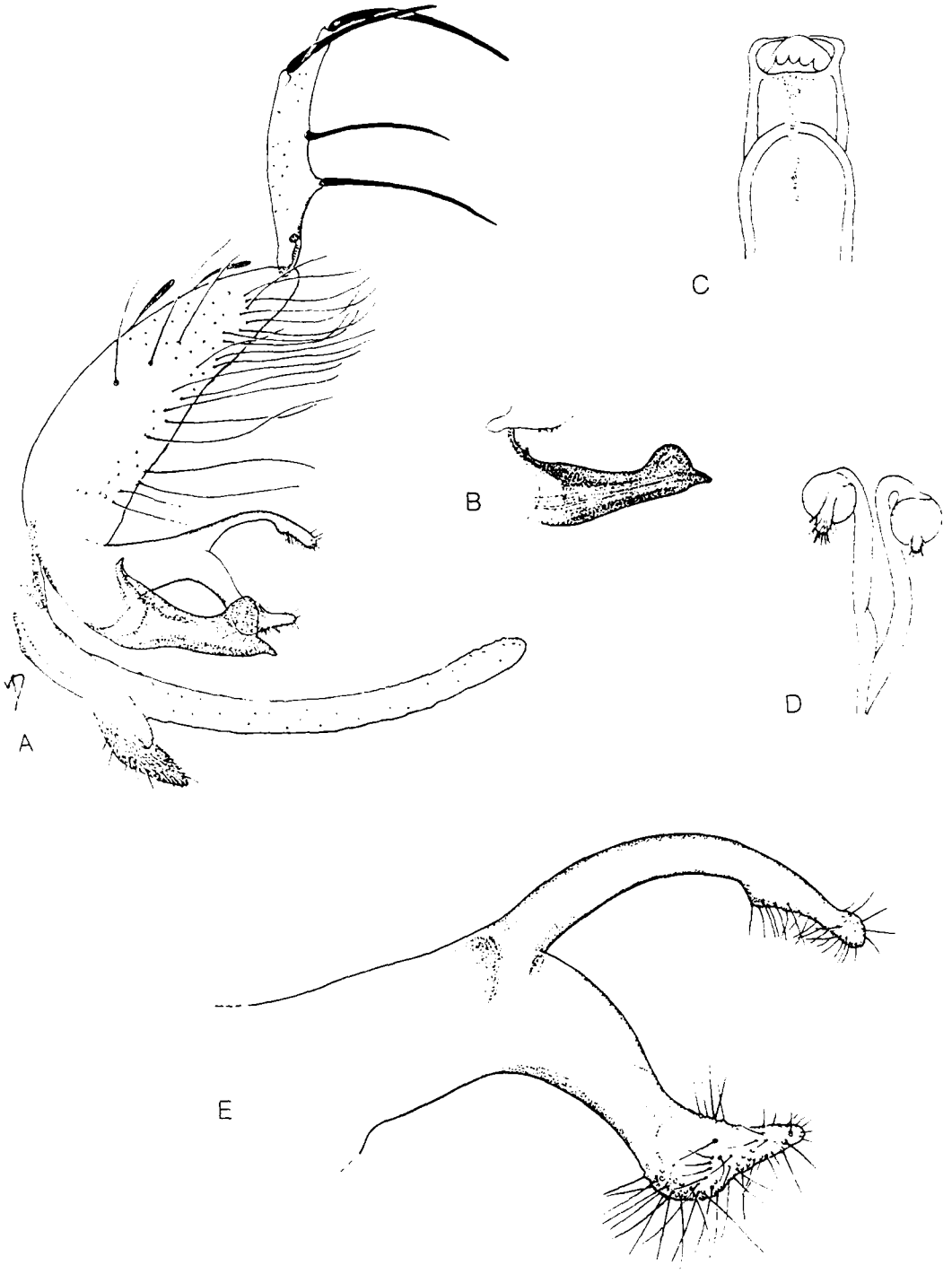



Plate 30-5

Lutzomyia conviti. A. Male terminalia; B. Aedeagus; C. Female cibarium; D. Spermathecae; E. Paramere (female figs. from Ramirez Perez et al. 1976).

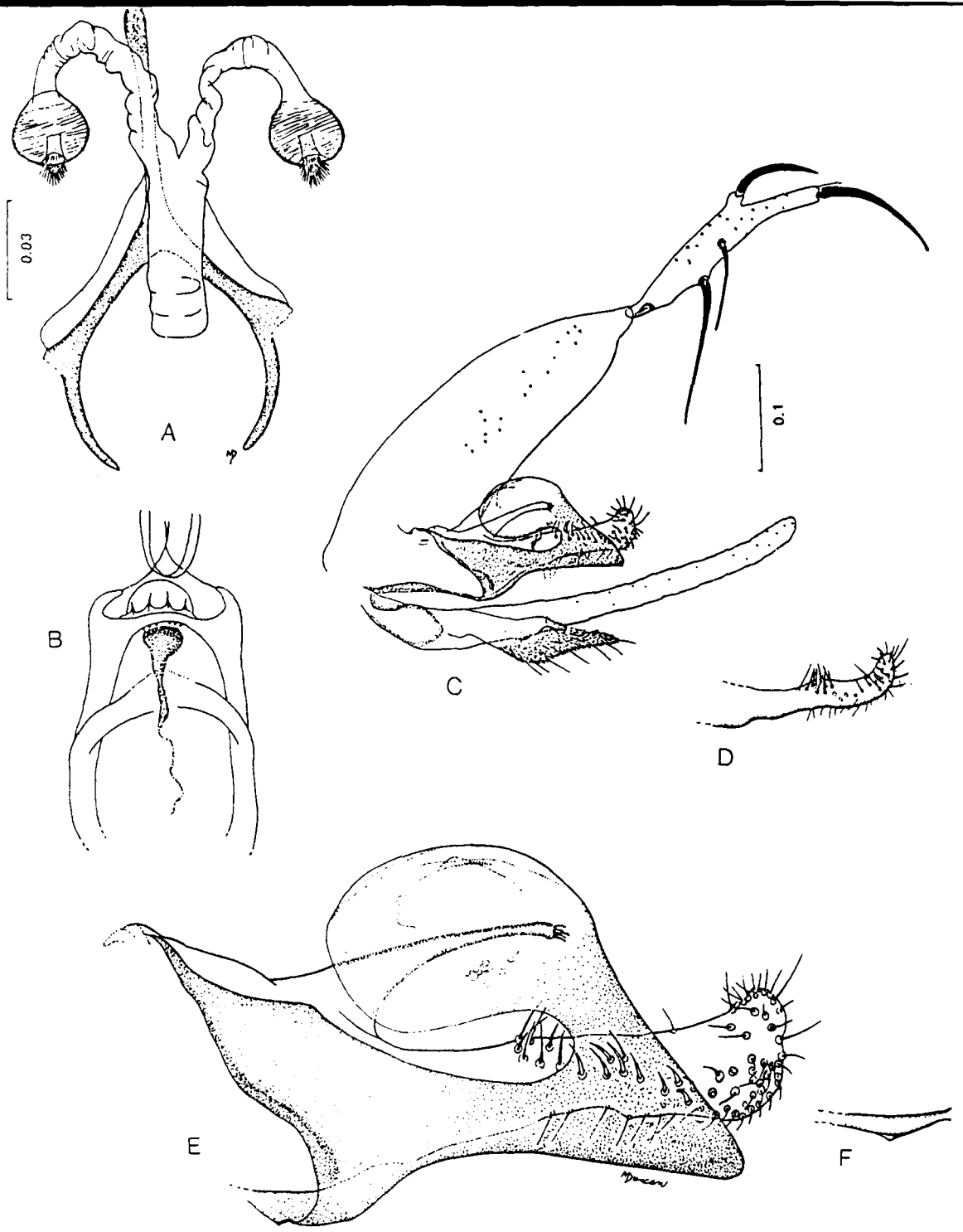



Plate 30-6

Lutzomyia dasypodogeton. A. Spermathecae, B. Female cibarium, C. Male terminalia, D. Paramere, E. Paramere & aedeagus, F. Tip of genital filament.

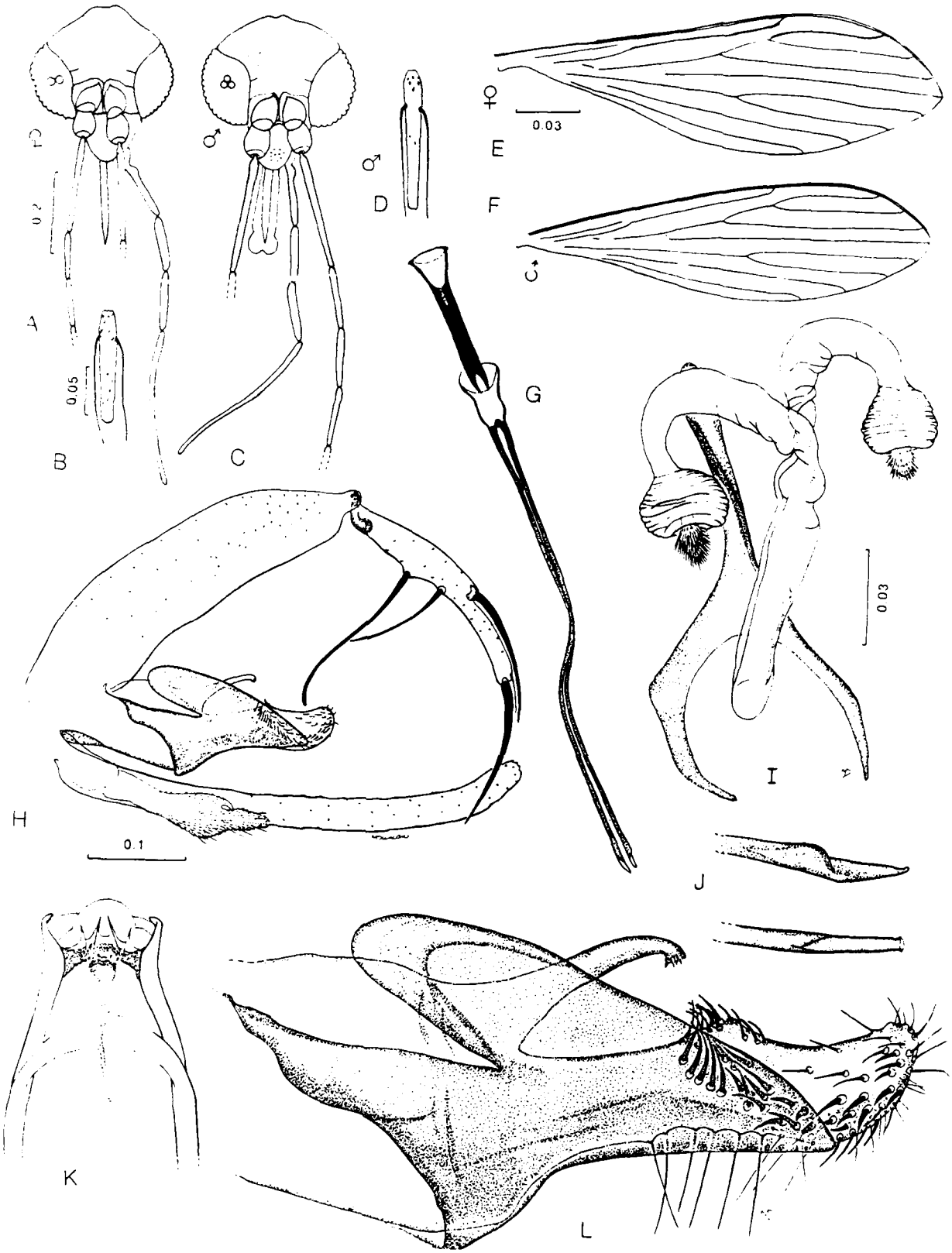



Plate 30-7

Lutzomyia (Trichopygomyia) n.sp. #1. A Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Male terminalia; I. Spermathecae; J. Tips of genital filaments; K. Female cibarium; L. Paramere & aedeagus.

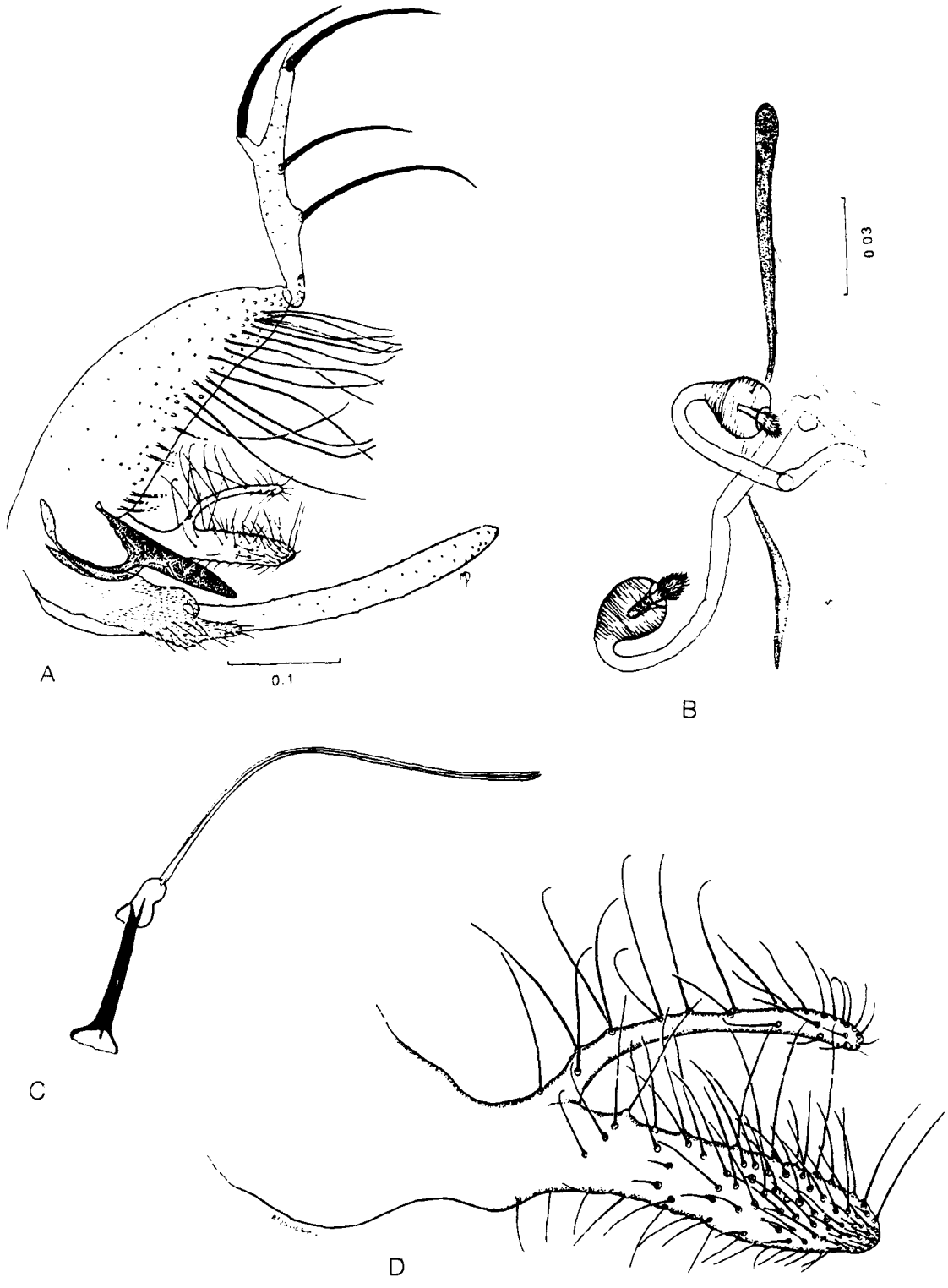



Plate 30-8

Lutzomyia trichopyga. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Paramere.

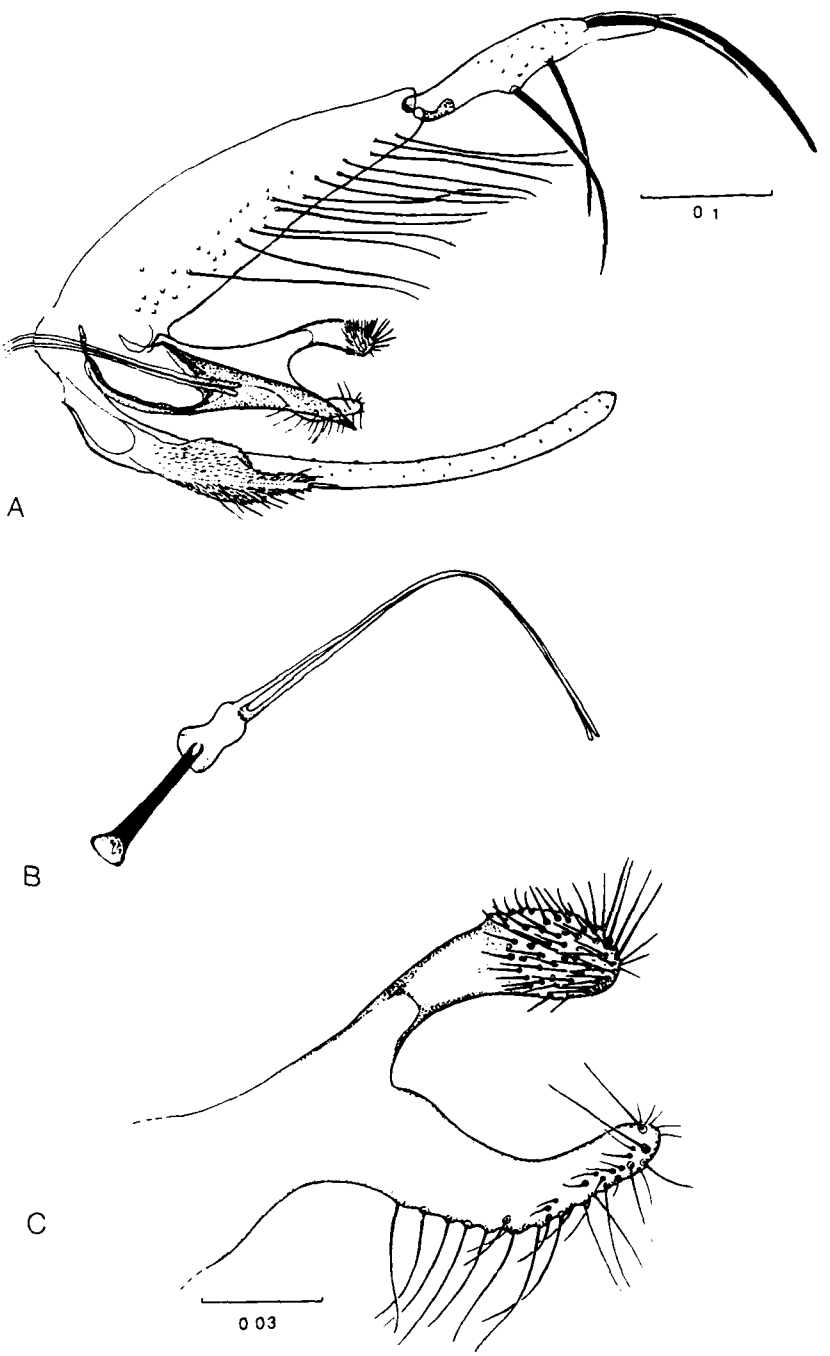



Plate 30-9

Lutzomyia rondonensis. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

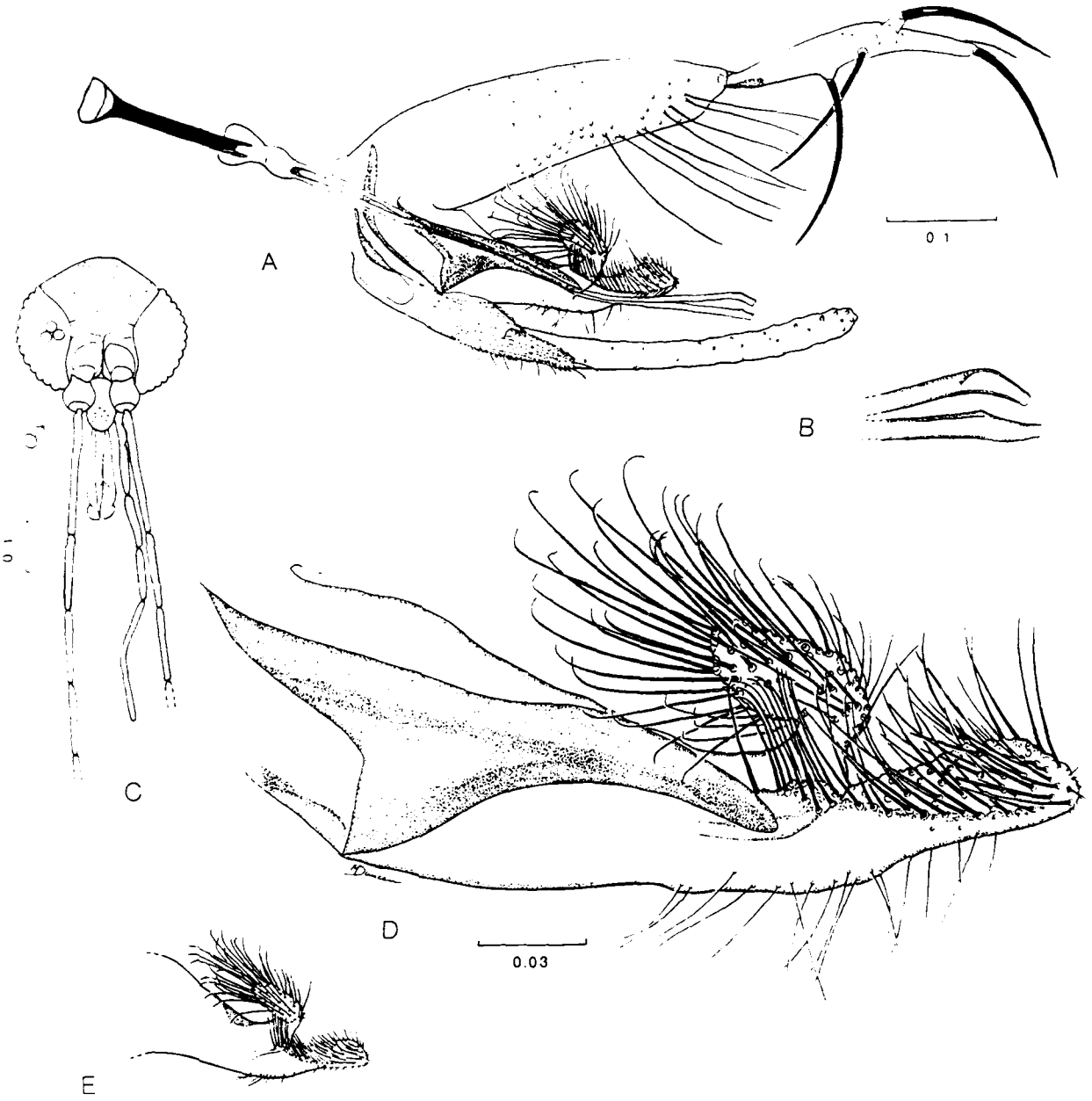



Plate 30-10

Lutzomyia witoto. A. Male terminalia; B. Tips of genital filaments; C. Male head; D. Paramere & aedeagus; E. Paramere (figs. after Young & Morales 1987).

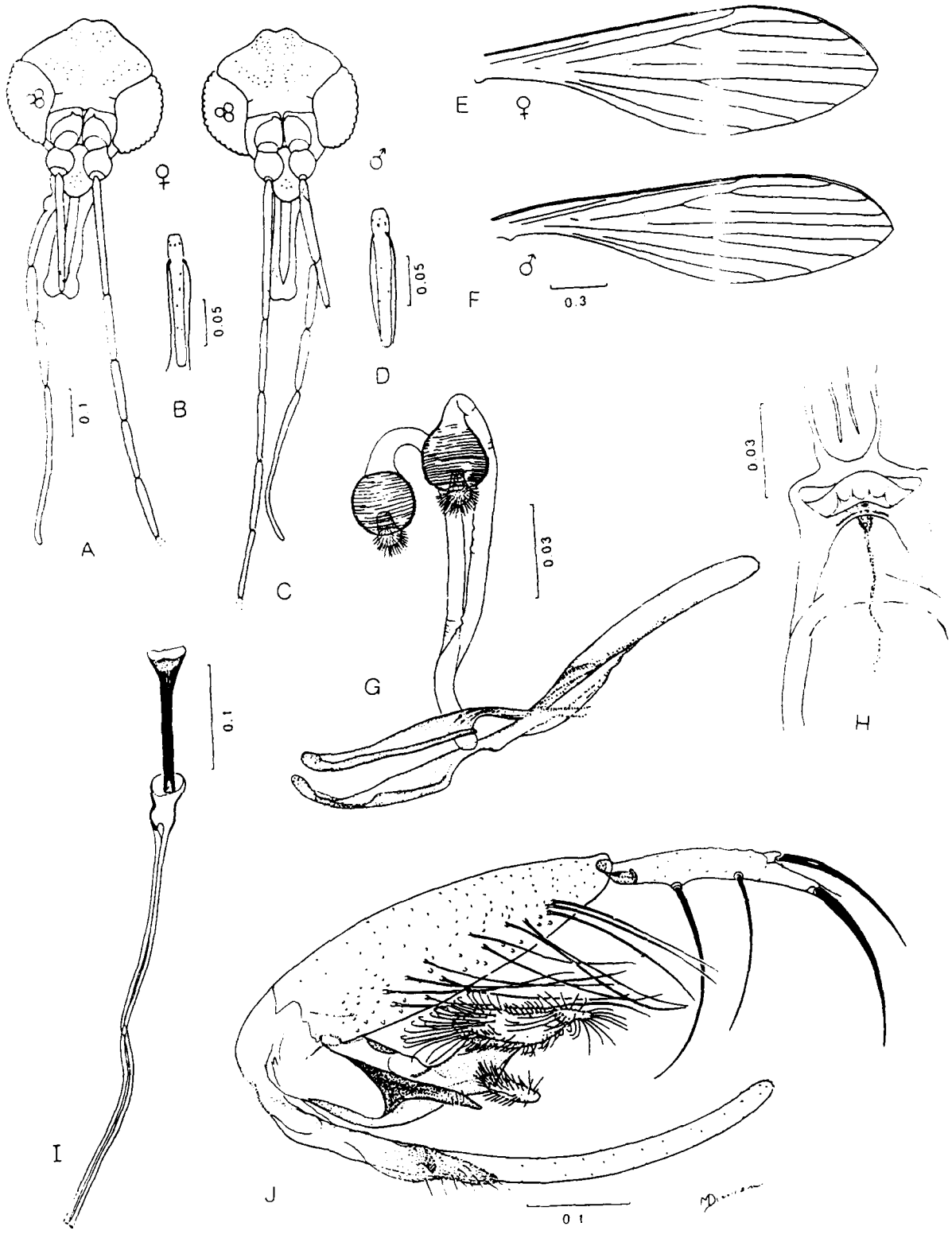



Plate 30-11

Lutzomyia ferroae. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Male terminalia (figs. after Young & Morales 1987).

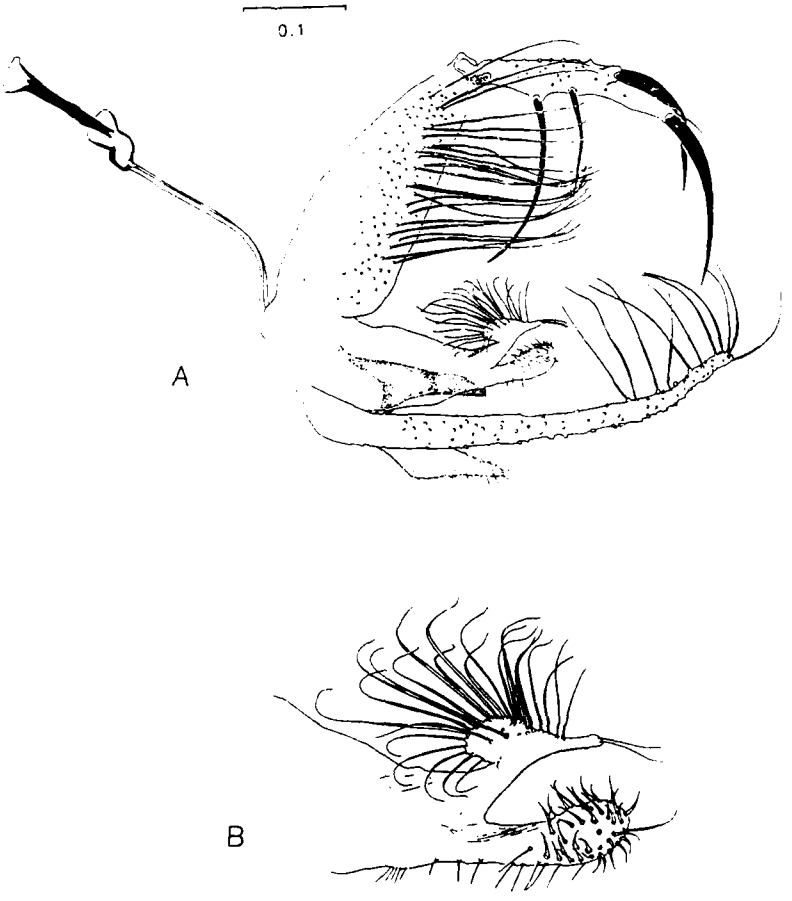



Plate 30-12

Lutzomyia ratcliffei. A. Male terminalia; B. Paramere (figs. from Arias et al. 1983).

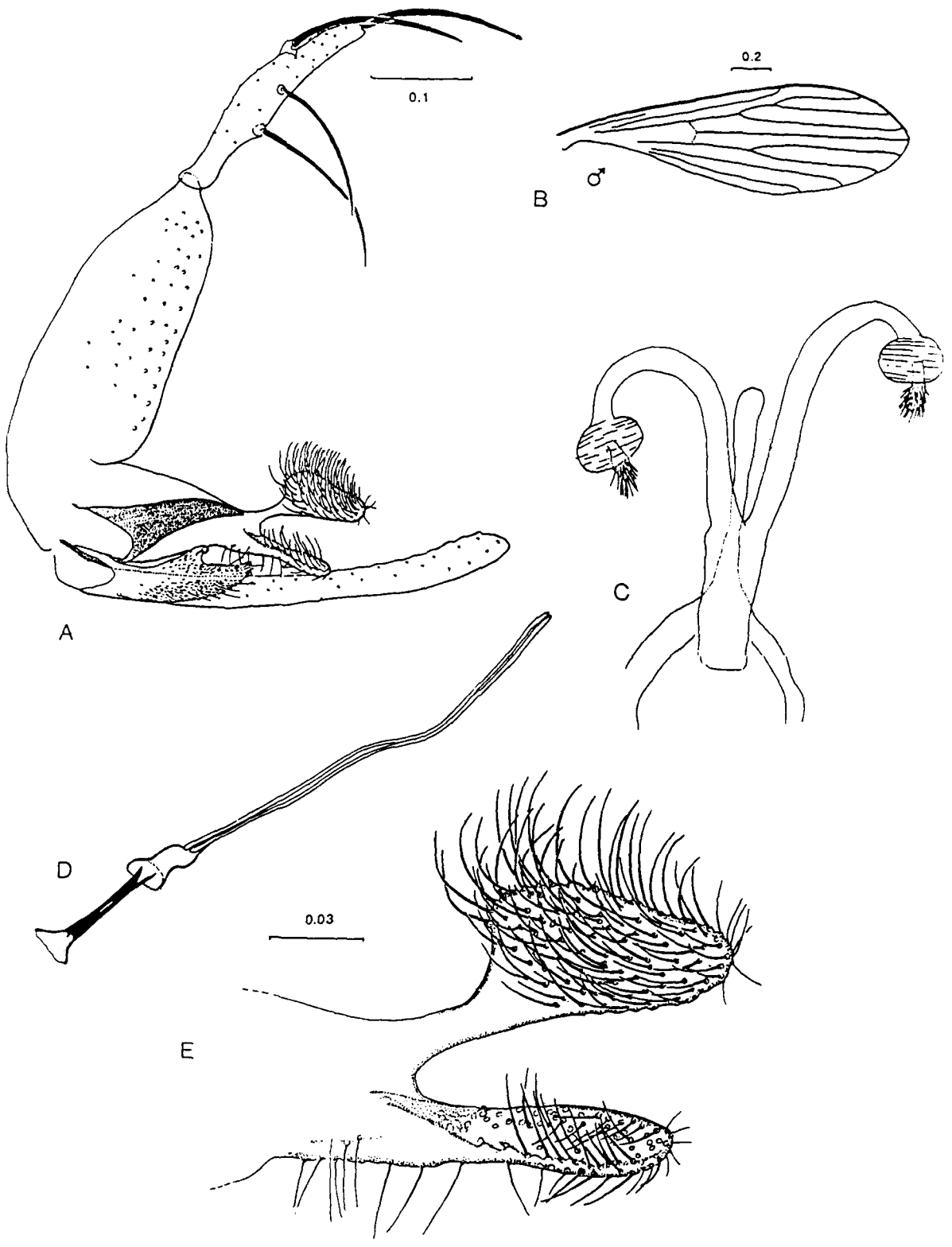



Plate 30-13

Lutzomyia wagleyi. A. Male terminalia; B. Male wing; C. Spermathecae; D. Genital pump & filaments; E. Paramere.

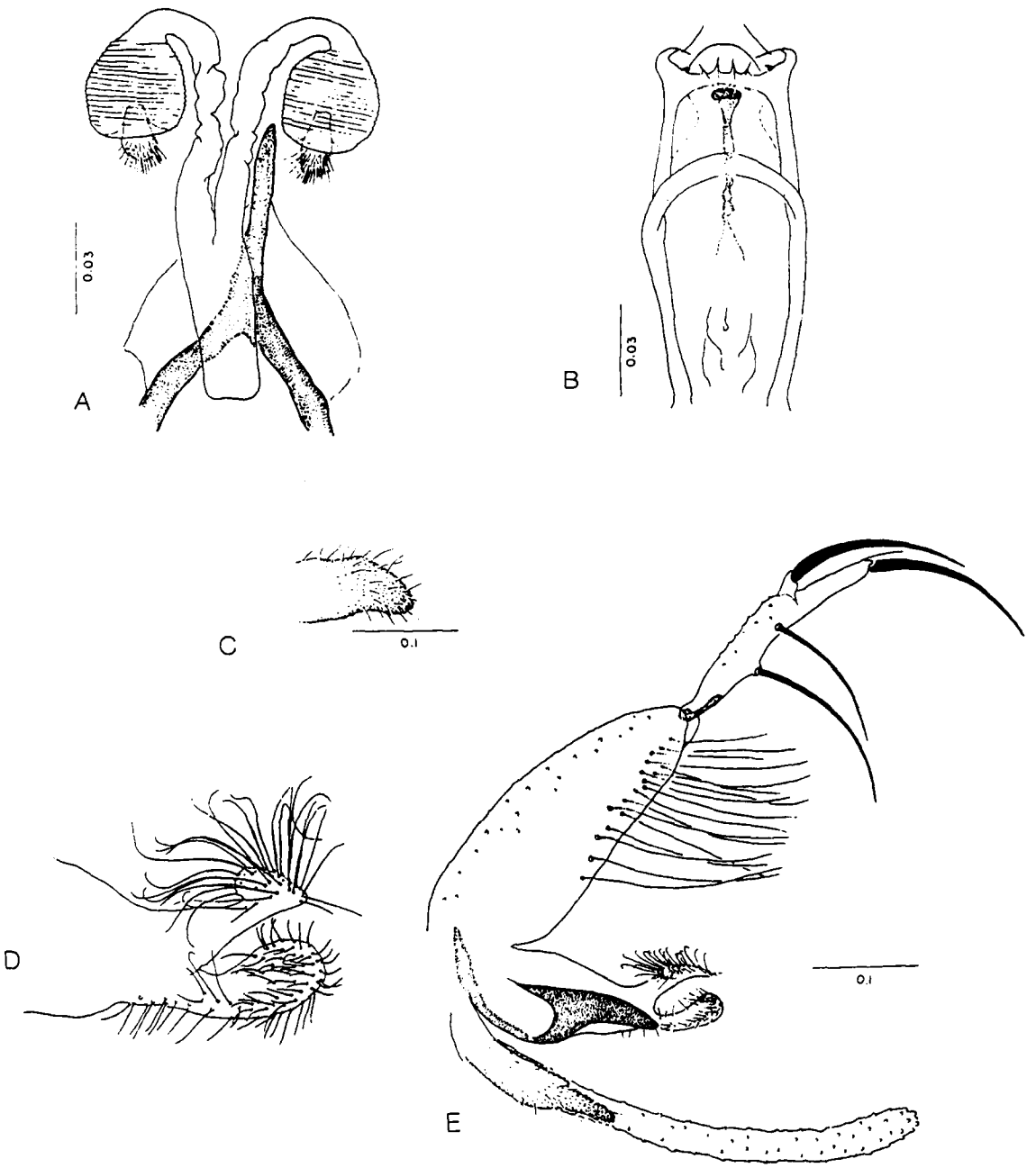
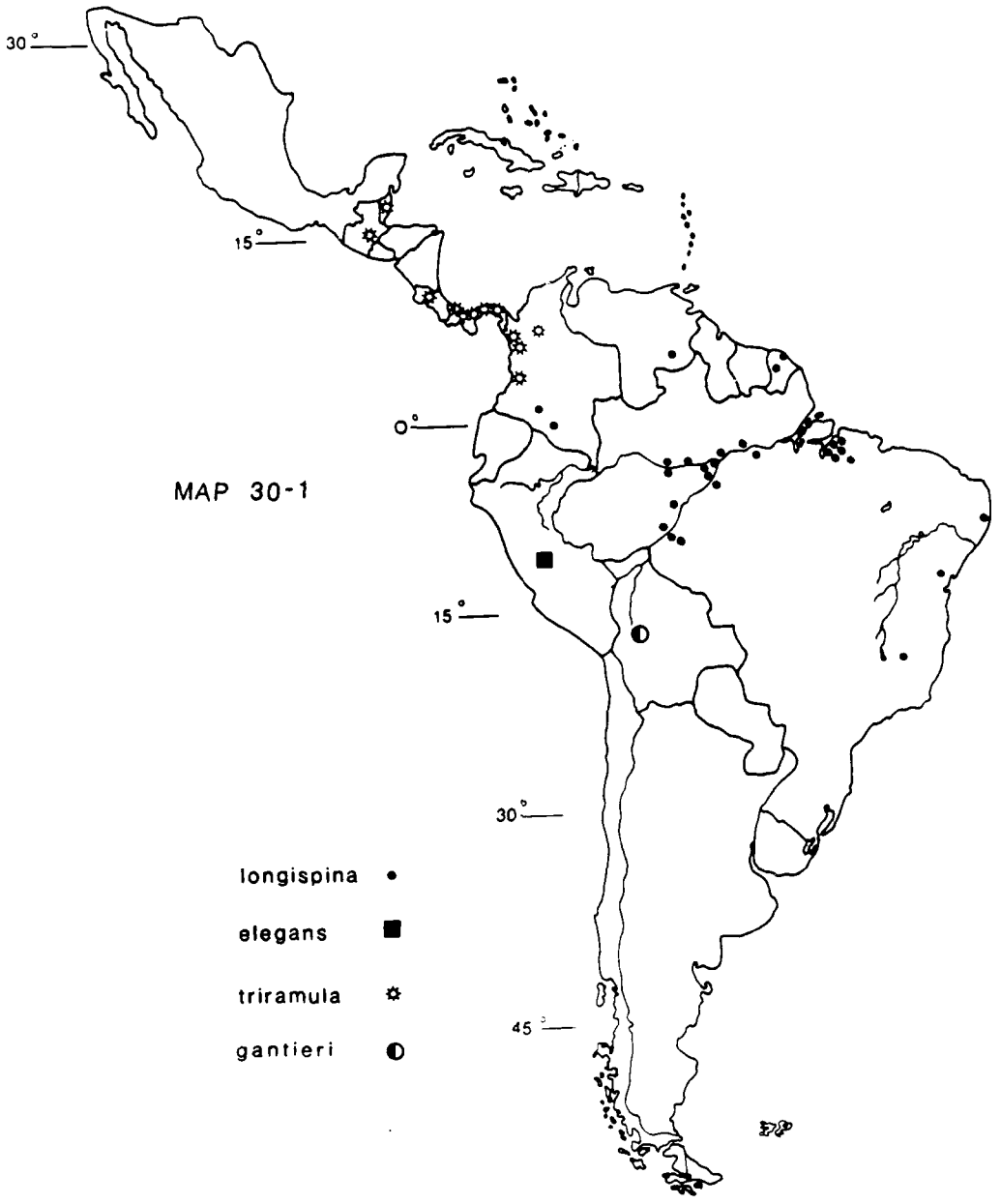
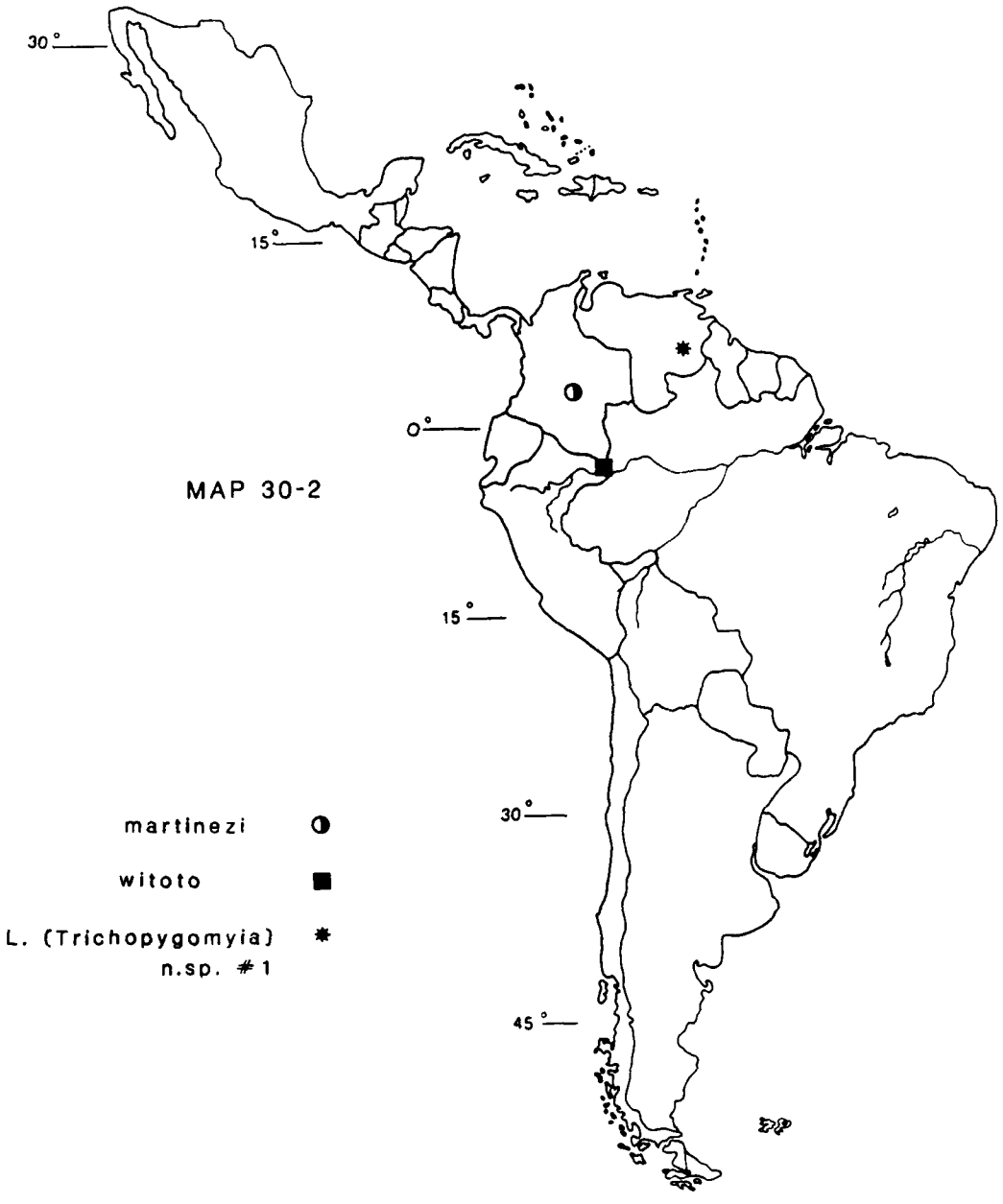



Plate 30-14

Lutzomyia longispina. A. Spermathecae; B. Female cibarium; C. Female cercus; D. Paramere; E. Male terminalia (fig. D from Arias et al. 1983; others from Young 1979).




MAP 30-1




MAP 30-2




MAP 30-3


30°
15°
0°
15°
30°
45°
MAP 30-4
dasypodegton


30°
15°
0°
15°
30°
45°
MAP 30-5
rondoniensis
ferroae




MAP 30-6

trichopyga ✡

## 31. Lutzomyia Subgenus Nyssomyia Barretto

Lutzomyia subgenus Nyssomyia Barretto 1962: 98 (type species: Phlebotomus intermedius Lutz & Neiva by orig. designation). Lewis et al. 1977: 325. Martins et al. 1978: 94 (defined). Ready & Fraiha 1981: 705 (defined, ♂♂ , ♀♀ keyed).

Lutzomyia species group intermedia Theodor 1965: 184 (defined).

Psychodopygus subgenus Trichophoromyia: Forattini 1971a: 105; 1973: 415 (in part, defined).

Identification. Coloration variable, pale to well-pigmented. Antennal ascoids simple. *Palpomere* 5 usually shorter than palp. 3 (L. waltoni is exception). ♀ cibarium with 6 or more horizontal teeth & complete arch. Spermathecae annulated, longer than wide; terminal knob large. ♂ genitalia: Coxite with or without persistent setae (if present, they are simple & inserted at or near middle of coxite). Style with 4 spines, none of which is inserted on a long tubercle or process; subterminal seta absent. Paramere undivided with simple setae.

Species in the subgenus Trichophoromyia Barretto, as defined in the present review, share many character states with the Nyssomyia species but the antennal ascoids have short (barely discernible) spurs, the pleura are nearly as dark as the scutum in most species and the female cerci are characteristically short and broad.

Medical Importance. Most species in this subgenus are anthropophilic, the degree varying according to species. Several species are suspected or proven vectors of leishmaniasis and arboviruses.

Key to the males of the subgenus Nyssomyia*

1. Style with paired basal spines, inserted more or less at the same level. ..... 2

   Style with isolated basal spine. ..... 18

2. Coxite with a median group of 20+ simple setae. .....

   ..... L. antunesi (Pl. 31-5)

   Coxite without a group of persistent setae. ..... 3

3. Scutum pale, with little or no pigmentation. ..... 4

   Scutum pigmented, contrasting with pale pleura. ..... 7

4. Genital filament tips with 1 or 2 barbs.... L. yuilli yuilli (Pl. 31-15)

   L. yuilli pajoti

   Genital filament tips without such barbs. ..... 5

5. Gential filament tips forked; one fork spatulate, the other pointed and shorter. ..... L. anduzei (Pl. 31-10)

   Genital filament tips simple, slightly expanded. ..... 6

---

*Modified from Ready & Fraiha (1981).

6. Palpomere 5 subequal in length to palp. 3. ..... L. trapidoi (Pl. 31-13)

Palpomere 5 much longer than palp. 3. ..... L. waltoni (Pl. 31-16)

7. Scutum bicolored; anterior 1/2 of scutum & pronotum heavily pigmented; posterior 1/2 of scutum & scutellum pale. ..... 8

Scutum unicolored, scutellum also with faint or moderate pigmentation. ..... 11

8. Genital pump relatively large (ca. 0.20 mm long), filaments shorter than 2.5X pump length. Lateral lobes extend slightly beyond end of parameres. ..... L. flaviscutellata (Pl. 31-1)

Genital pump shorter ( <0.19 mm long), filaments longer than 2.8X pump length. Lateral lobes project well beyond end of parameres. ... 9

9. Palpomere 5 about same length as palpomere 3. Lateral lobe longer than 0.36 mm or as long as coxite ..... L. olmeca olmeca (Pl. 31-2)

Palpomere 5 shorter than palpomere 3. Lateral lobe shorter than 0.35 mm or coxite. ..... 10

10. Lateral lobe <0.25 mm long. Flagellomere I <0.35 mm. Eyes larger, separated by distance = to only 0.035-0.040 mm; interocular suture usually absent. ..... L. olmeca nociva (Pl. 31-4)

Lateral lobe >0.25 mm. Flagellomere I longer than 0.38 mm. Eyes smaller, separated by at least 0.075 mm; interocular suture not complete, represented by reduced suture lines between eyes. ..... L. olmeca bicolor (Pl. 31-3)

11. Style with proximal 2 spines inserted within distal 1/3 of structure. ..... L. inornata (Pl. 31-1)

Style with proximal 2 spines inserted at middle 1/3 of structure. ... 12

12. Genital filaments shorter, equal to, or slightly longer than 2X pump length. ..... 13

Genital filaments at least 2.3X pump length. ..... 17

13. Style with 2 terminal spines close together, separated by distance = to greatest width of terminal spine. ..... 14

Style with terminal spines more widely separated. ..... 15

14. Pronotum and paratergite heavily infuscated. ... L. edentula (Pl. 31-12)

Pronotum and paratergite pale. ..... L. ylephiletor (Pl. 31-14)

15. Genital filament tips spatulate, unforked. Prescutum heavily pigmented. ..... L. intermedia (Pl. 31-9)

Gential filament tips simple or forked. Prescutum pale or lightly pigmented. ..... 16

16. Genital filament tips forked. ..... L. umbratilis (Pl. 31-11)

Gential filaments tips unforked, slightly diliated. .....

..... L. trapidoi* (Pl. 31-13)

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*Specimens of L. trapidoi, or unnamed sibling species, occurring in Pacific Coast forests of Colombia and Ecuador are moderately infuscated, unlike the type material from Panama (Young 1979).

17. Coxite with median group of 20+ long persistent setae. ..... 18

Coxite without persistent setae. ..... 19

18. Pronotum & paratergite pale.* ..... L. richardwardi (Pl. 31-17)

Pronotum & paratergite heavily pigmented. ..... L. shawi (Pl. 31-17)

19. Pronotum pale. Genital filaments usually longer than 3.3X length of pump. ..... L. whitmani (Pl. 31-7)

Pronotum heavily pigmented. Genital filaments usually shorter than 3.3X length of pump. ..... L. hernandezi (Pl. 31-6)

L. sylvicola (Pl. 31-8)

---

*Paratergite corresponds to the prescutum as shown by Ready & Fraiha (1981).

Key to females in the subgenus Nyssomyia*

1. Common sperm duct long, extending to distal 1/3 of genital fork or beyond. ..... 2

- Common sperm duct absent or short, not extending to distal 1/3 of genital fork. ..... 6

2. Spermatheca with fewer than 8 distinct annuli, its length (including terminal knob) about 1/2 length of individual sperm duct. Head height subequal to its width. Scutum not bicolored. ..... ..... L. antunesi (Pl. 31-5)

- Spermatheca with 8 or more distinct annuli, its length subequal to, or longer than, individual sperm duct. Head longer than wide. Scutum bicolored, anterior 1/2 of scutum & pronotum heavily pigmented; posterior 1/2 of scutum & scutellum pale. ..... 3

3. Cibarium with 6-7 horizontal teeth. Stem of genital fork slender. ..... L. flaviscutellata (Pl. 31-1)

Cibarium with 8-12 (rarely 7) horizontal teeth. Stem of genital fork broad, blade-like. ..... 4

4. Spermatheca with short & broad terminal knob & ca. 12-13 distinct annuli. ..... L. olmeca olmeca (Pl. 31-2)

Spermathecae with longer, more slender terminal knob & 9-12 distinct annuli. ..... 5

---

*The females of L. sylvicola and L. inornata have not been described.

5. Common & individual sperm ducts subequal in length. .....
..... L. olmeca nociva (Pl. 31-4)
Common sperm duct much longer than individual sperm duct. .....
..... L. olmeca bicolor (Pl. 31-3)

6. Individual sperm ducts with refringent excressences or papules. .....
..... 7
Individual sperm ducts either smooth walled, without refringent excressences, or with transverse striations. ..... 8

7. Individual sperm ducts with widely-spaced, spherical papules; width of individual ducts subequal throughout.... L. yuilli pajoti (Pl. 31-15)
Individual sperm ducts mostly with continuous, elongate papules *forming a feather-like pattern*, those at base larger than others; basal portion of individual duct wider than distal portion. .....
..... L. yuilli yuilli (Pl. 31-15)

8. Spermatheca subequal to or longer than individual duct. ..... 9
Spermatheca shorter than individual duct. ..... 11

9. Common & individual sperm ducts with distinct transverse striations. Mesonotum lightly to moderately infuscated.... L. umbratilis (Pl. 31-11)
Common & individual sperm ducts completely or mostly smooth-walled. Mesonotum strongly infuscated. ..... 10

10. Pronotum & prescutum strongly infuscated. Individual sperm ducts greater than 1/2 length of spermatheca. ..... L. shawi (Pl. 31-17)
Pronotum & prescutum pale or nearly pale. Individual sperm ducts only about 1/3 length of spermatheca. ..... L. richardwardi (Pl. 31-17)

11. Spermatheca with 5-7 distinct annuli. Pronotum pale. ..... 12
Spermathecae with 8 or more distinct annuli. Pronotum dark. ..... 15

12. Individual sperm duct shorter than 2X length of spermatheca. Incipient annuli usually present at base of spermatheca; basal annuli smaller than distal annuli. ..... 13
Individual sperm duct longer, 2X or more length of spermatheca. Incipient annuli absent at base of spermatheca, all spermathecal annuli, except sometimes the most basal, subequal in size. ..... 14

13. Mesonotum strongly infuscated. Terminal knob of spermatheca as broad as terminal annulus. ..... L. ylephiletor (Pl. 31-14)
Mesonotum pale or nearly so. Terminal knob of spermatheca more slender than terminal annulus. ..... L. anduzei (Pl. 31-10)

14. Common sperm duct present & nearly as long as spermatheca; individual ducts long and with fine transverse striations throughout. ..... ..... L. waltoni (Pl. 31-16)
Common sperm duct absent; individual ducts shorter & completely smooth-walled. ..... L. trapidoi (Pl. 31-13)

15. Spermatheca with 8-10 annuli; individual sperm ducts increasing in width from base to junction of spermathecae. ..... 16

Spermatheca with 12 or more annuli; individual sperm ducts subequal in width throughout. ..... 17

16. Spermatheca with annuli increasing in size from base to apex. Common sperm duct present, relatively wide & long. .... L. edentula (Pl. 31-12)

Spermatheca with annuli subequal in size. Common duct, if visible, much shorter. ..... L. intermedia (Pl. 31-9)

17. Individual sperm duct 3-4X length of spermatheca. .....
..... L. whitmani (Pl. 31-7)

Individual sperm duct less than 2.5X length of spermatheca.
..... L. hernandezi (Pl. 31-6)

Lutzomyia (Nyssomyia) flaviscutellata (Mangabeira)

Plate 31-1

Flebotomus flaviscutellatus Mangabeira 1942a: 144 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 201 (refs.).

Phebotomus apicalis Floch & Abonnenc 1943a: 25 (♂. ♀ French Guiana). Barretto

1946b: 534 (as junior synonym of flaviscutellatus).

Lutzomyia flaviscutellata: Barretto 1962: 98 (listed). Theodor 1965: 184 (listed). Fairchild & Theodor 1971: 153 (♂, ♀, tax. review). Llanos

1973: 32 (Peru, figs.). Lewis 1975a: 501 (mouthpart morphol.); 1975b: 363 (tax.). Ward & Ready 1975: 128 (egg descript.). Ward 1976: 230 (tax., larva, pupa). Leger et al. 1977: 220 (French Guiana). Arias & Freitas 1977: 55 (in part, coll. data, Amazonas, Brazil); 1978: 391 (in part, negative for flagellates). Fraiha et al. 1978: 136 (N. Brazil). Ramirez-Perez et al. 1978: 49 (? misident., Venezuela, figs.). Ward et al. 1978: 272 (feeding through membranes). Martins et al. 1978: 98 (refs., dist.). Young 1979: 153 (♂, ♀, refs., figs.). Lainson et al. 1979: 241 (negative for flagellates, Pará, Brazil). Leger et al. 1980: 116 (French Guiana). Feliciangeli 1980: 246. Fraiha et al. 1980a: 21 (Peru). Ramirez-Perez et al. 1981: 124 (? misident., Venezuela). Ready & Fraiha 1981: 708 (keyed). Shaw 1981: 232 (as experimental host for Endotrypanum). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young & Arias 1982: 198 (tax.). Ready et al. 1983: 780 (Pará, Brazil). Lainson et al. 1983: 326 (Marajo Island, Pará, Brazil). Ready et al. 1983: 775 (ecology, disease relationships, N. Brazil). Ready et al. 1984b: 641 (age grading). Young & Rogers 1984: 599 (Ecuador). Herve et al. 1984: 207 (vertical transmission, Pacui virus). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Dedet et al. 1985: 503 (seasonal dist., natural Leishmania infections, French Guiana). Young et al. 1985: 143 (Peru). Cuba Cuba et al. 1985: 503 (experimental infections with (Leishmania). Hudson & Young 1985: 418 (Seriname). Ward 1985: 205 (ecology). Le Pont & Desjeux 1986: 314 (Bolivia). Ready et al. 1986: 29 (Pará, Brazil). Ryan 1986: 64 (refs., figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Ryan et al. 1987a: 356 (nat. flagellate infections, Pará, Brazil).

Psychodopygus flaviscutellatus: Forattini 1971a: 105 (listed); 1973: 170 (gen. review).

Distribution (Map 31-1). Colombia (Young 1979; ♂♂, ♀♀, Rio de Oro, Norte de Santander, A. Morales); Venezuela (Pifano et al. 1973); Suriname (Martins et al. 1978; Hudson & Young 1985); French Guiana (Martins et al. 1978; Leger et al. 1977); Brazil (Martins et al. 1978; Fraiha et al. 1978; Bianchardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Peru (Llanos 1973; 1981; Young et al. 1985); Ecuador (Young 1979); Bolivia (Le Pont & Desjeux 1986); Trinidad (Tikasingh 1975).

Remarks. Lutzomyia flaviscutellata is a proven vector of Leishmania amazonensis in Brazil and French Guiana (see Young & Lawyer 1987 & Arias et al. 1987). Pacui virus, associated with small mammals in northern Brazil, may be transmitted by L. flaviscutellata (Aitken et al. 1975).

This species was reported in Aragua State, Venezuela by Ramirez Perez et al. (1978) but their illustrations (Fig. 8) are more suggestive of L. olmeca bicolor.

The status of specimens from Salvador, Bahia, Brazil, reported as L. flaviscutellata by Sherlock & Carnheiro (1962) remains to be clarified (Lewis 1975a).

Lutzomyia flaviscutellata, the polytypic L. olmeca and possibly L. inornata form the flaviscutellata complex of the subgenus Nyssomyia. The striking coloration of these species, among the other character

states (Fairchild & Theodor 1971 & Lewis 1975b), enables workers to identify specimens rapidly and with certainty (Young & Arias 1982 & keys in present review).

Lutzomyia (Nyssomyia) inornata Martins, Falcão & Silva

Plate 31-1

Lutzomyia inornata Martins, Falcão & Silva 1965: 14 (♂, Guajará-Mirim, Rondonia, Brazil). Martins et al. 1978: 99 (dist.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready & Fraiha 1981: 709 (keyed). Young & Arias 1982: 134 (cf. to other flaviscutellata complex spp.).

Psychodopygus inornatus: Forattini 1971a: 105 (listed); 1973: 471.

Distribution (Map 31-2). Brazil (Martins et al. 1978; Biancardi et al. 1982).

Remarks. We have not seen specimens referable to L. inornata, the female of which remains unknown. The record of this species in French Guiana (Leger et al. 1977) was a misidentification of L. flaviscutellata (Young & Arias 1982). The males of the two species are not structurally separable with certainty and we believe they may be conspecific.

Lutzomyia (Nyssomyia) olmeca olmeca (Vargas & Najera)

Plate 31-2

Phlebotomus olmecus Vargas & Najera 1959: 147 (♂, Tabasco., Mexico; ♀ allotype = P. ylephiletor Fchld. & Hertig, not P. olmecus).

Phlebotomus apicalis (not P. apicalis Floch & Abonnenc): Lewis & Garnham 1959: 89 (♂, ♀, Belize, figs.).

Lutzomyia olmeca: Barretto 1962: 98. Theodor 1965: 184. Williams 1970: 333 (Belize). Zeledon & Murillo 1983: 280 (Nicaragua); Murillo & Zeledon 1985: 51 (dist. Costa Rica, figs).

Phlebotomus flaviscutellatus (not P. flaviscutellatus Mang.): Biagi et al. 1965b: 267 (as vector of Leishmania, Mexico); 1966: 141 (♀ fig., Mexico). Biagi 1966: 370 (keyed).

Lutzomyia olmeca olmeca: Fairchild & Theodor 1971: 153 (tax. review, figs., refs.). Lewis 1975a: 501 (mouthpart morphol.); 1975b: 363 (tax.). Ready & Fraiha 1981: 708 (keyed), Young & Arias 1982: 136 (tax.). Porter et al. 1987: 929 (Guatemala).

Psychodopygus olmecus: Forattini 1971a: 105; 1973: 434 (tax., figs.).

Distribution (Map 31-2). Mexico (Martins et al. 1978); Belize (Williams 1970); Guatemala (Porter et al. 1987); Honduras (Fairchild & Theodor 1971); Nicaragua (Zeledon & Murillo 1983); Costa Rica (Murillo & Zeledon 1985, in part).

Remarks. Lutzomyia olmeca olmeca is a proven vector of Leishmania mexicana among rodents and man in Mexico and Belize (see Williams 1970 for refs. & detailed information). Its geographic range extends into Costa Rica where J. Murillo & R. Zeledon (pers. comm.) have captured specimens in

the Valle de la Estrella, Limon Prov. and in La Virgen District, Heredia Prov.

Lutzomyia (Nyssomyia) olmeca bicolor Fairchild & Theodor

Plate 31-3

Lutzomyia olmeca bicolor Fairchild & Theodor 1971: 157 (♂ , ♀, Panama Canal Zone). Lewis 1975b: 363 (tax.). Martins et al. 1978: 101 (dist.). Young 1979: 155 (refs, figs.). Christensen & Herrer 1980b: 523 (feeding habits). Ready & Fraiha 1981: 708 (keyed). Arias & Frietas 1982: 401 (Acre, Brazil). Chaniotis et al. 1982: 3 (Panama, control trials). Young & Arias 1982: 136 (cf. to L. olmeca nociva). Christensen et al. 1983: 466 (relative abundance, Panama). Bonfante-Garrido 1983: 740 (Venezuela); 1984: 850 (Venezuela). Young & Rogers 1984: 599 (listed, Ecuador). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela).

Lutzomyia flaviscutellata (not P. flaviscutellatus Mang.): Ramirez Perez et al. 1978: 54 (Aragua, Venezuela).

Psychodophygus olmecus (in part): Forattini 1973: 434.

Distribution (Map 31-2). Costa Rica (Young 1979; Murillo & Zeledon 1985, in part); Panama (Fairchild & Theodor 1971; Young 1979); Colombia (Martins et al. 1978; Young 1971); Ecuador (Young 1979; Peru (♂ , Tambopata Reserve, Madre de Dios, E. Perez & D. Young); Venezuela (Bonfante Garrido 1984; Feliciangeli 1987a; 1987b); Brazil (Arias & Freitas 1982).

Remarks. Lutzomyia olmeca bicolor, a suspected vector of Leishmania aristidesi among rodents and marsupials at Sasardi, Panama (Christensen et al. 1972), is not strongly anthropophilic. It occurs with L. flaviscutellata in the Rio de Oro area of Norte de Santander Department, Colombia (A. Morales, pers. comm.) at Leticia, Colombia (Young 1979) and in Madre de Dios Department, Peru. Populations of this subspecies and L. o. olmeca are apparently allopatric in Costa Rica (J. Murillo & J. Peterson, pers. comm.).

## Lutzomyia (Nyssomyia) olmeca nociva Young & Arias

Plate 31-4

Lutzomyia olmeca nociva Young & Arias 1982: 134 (♂, ♀, near Manaus, Amazonas, Brazil). Ward 1985: 205. Arias et al. 1985: 1101 (negative for flagellates, Brazil); 1987: 48 (nat. infections of Leishmania amazonensis, Manaus, Brazil).

Distribution (Map 31-2). Brazil (Young & Arias 1982; J. Arias, unpubl. records).

Remarks. Females of this subspecies were among the five most common sand flies captured on human bait in the Manaus, Brazil area where some L. o. nociva were found naturally infected with Leishmania amazonensis (Arias et al. 1987).

Lutzomyia (Nyssomyia) antunesi (Coutinho)

Plate 31-5

Flebotomus antunesi Coutinho 1939: 181 (♂, Manacapurú, Amazonas, Brazil). Barretto 1947a: 185 (full refs.).

Phlebotomus machicouensis Floch & Abonnenc 1944d: 8 (♀, Machicou, French Guiana); 1952: 184 (redescript.). Martins et al. 1965: 2 (resembles antunesi). Theodor 1965: 184 (as synonym of antunesi).

Lutzomyia antunesi: Barretto 1962: 97 (listed). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 97 (refs., dist.). Fraiha et al. 1978: 136 (Brazil). Young 1979: 151 (refs, figs.). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 96 (Colombia). Ready & Fraiha 1981: 709 (keyed). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ramirez Perez et al. 1982b: 57 (♂, ♀ figs., Tachira, Venezuela). Llanos 1981: 183 (listed, Peru). Lainson et al. 1983: 326 (Marajo Island, Brazil). Ryan et al. 1984: 547 (nat. infected with promastigotes, Brazil). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 63 (♂, ♀ figs, Brazil). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Ryan et al. 1987a: 356 (negative for flagellates, Brazil).

Distribution (Map 31-3). Colombia (Young 1979; Morales & Minter 1981); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1982b); Trinidad (Aitken et al. 1968; Young 1979); Suriname (Wijers & Linger 1966);

French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Brazil (Fraiha 1978; Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Lainson et al. 1983; Ryan 1986); Peru (Llanos 1981; Young et al. 1985); Bolivia (♂, ♀, Guayamarin, Beni, J. Velasco).

Remarks. Lutzomyia antunesi, an anthropophilic species once found naturally infected with flagellates in Brazil (Ryan et al. 1984), is widespread in the Amazon basin. Some females from Peru, illustrated and identified as L. antunesi by Llanos (1973) actually represent L. yuilli yuilli.

Ward (1976) described and illustrated the fourth instar larva of L. antunesi. The egg shell structure was earlier illustrated by a SEM micrograph (Ward & Ready 1975).

## Lutzomyia (Nyssomyia) hernandezi (Ortiz)

Plate 31-6

Phlebotomus hernandezi Ortiz 1965c: 412 (♂, near Caja Seca, Trujillo, Venezuela).

Psychodopygus hernandezi: Forattini 1971a: 105; 1973: 468 (♂).

Lutzomyia hernandezi: Martins et al. 1978: 99 (refs.). Ramirez Perez et al. 1979: 259 (♂, ♀, Tachira, Venezuela). Feliciangeli 1980: 246. Ready & Fraiha 1981: 709 (♂, keyed). Ramirez Perez et al. 1982b: 50 (♂, ♀ figs, Tachira, Venezuela). Arias et al. 1984: 326 (cf. to waltoni). Young & Morales 1987: 651 (Colombia).

Distribution (Map 31-4). Venezuela (Ortiz 1965c; Ramirez Perez et al. 1982b); Colombia (Young & Morales 1987).

Remarks. Both sexes of L. hernandezi resemble those of L. whitmani but, among other differences noted in the keys, the pronotum is heavily pigmented in the former species, pale in whitmani.

## Lutzomyia (Nyssomyia) whitmani (Antunes & Coutinho)

Plate 31-7

Flebotomus whitmani Antunes & Coutinho 1939: 4 (♂, ♀ Ileus, Bahia, Brazil). Barretto 1947a: 230 (full refs., synonyms).

Phlebotomus intermedius (not intermedius Lutz & Neiva) Floch & Abonnenc 1941a: 2 (♂, French Guiana).

Phlebotomus intermedius longiductus Floch & Abonnenc 1942a: 3 (♂, French Guiana).

Phlebotomus intermedius acutus Floch & Abonnenc 1942a: 3 (♂, French Guiana).

Phlebotomus longiductus (not longiductus Parrot) Floch & Abonnenc 1944e: 10 (♂, French Guiana).

Phlebotomus elongatus Floch & Abonnenc 1945d: 1 (new name for longiductus Floch & Abonnenc).

Flebotomus elongatus: Barretto 1947a: 197 (refs.).

Lutzomyia elongata: Barretto 1962: 98 (listed). Theodor 1965: 184 (listed). Leger et al. 1977: 223 (as synonym of whitmani). Martins et al. 1978: 98. Ready & Fraiha 1981: 710 (as valid species, distinct from whitmani).

Lutzomyia whitmani: Barretto 1962: 98 (listed). Theodor 1965: 184 (listed). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Leger et al. 1977: 223 (French Guiana). Martins et al. 1978: 102 (refs., dist.). Lainson et al. 1979: 240 (nat. infect with Leishmania, Pará, Brazil). Mayrink et al. 1979: 131 (nat. infected with gregarines, fungi, bacteria, Minas Gerais, Brazil). Leger et al. 1980: 117 (French Guiana). Ready & Fraiha 1981: 708 (keyed). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Ready et al. 1986: 27 (NE Brazil). Vexenat et al. 1986a: 125 (exper. infections with Leishmania braziliensis); 1986b: 296 (Bahia, Brazil). Ryan 1986: 69 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (nat. Leishmania infections, Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus whitmani: Forattini 1971a: 105 (listed); 1973: 425 (♂, ♀ figs., tax., gen. review).

Distribution (Map 31-5). French Guiana (Floch & Abbonnenc 1952: Leger et al. 1977); Brazil (Lainson et al. 1976; Martins et al. 1978; Lima et al. 1981; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Peru (Young et al. 1985); Paraguay and Argentina (Martins et al. 1978).

Remarks. Lutzomyia whitmani has been found naturally infected with Leishmania braziliensis on several occasions from 1985 to 1987 in the vicinity of Tres Bracos, Bahia, Brazil where it is a common man-biter (A.L. Hoch, pers. comm.). In addition, Leishmania guyanensis has been recovered from whitmani females in Amazonas and Pará States, Brazil where it is regarded as a secondary vector (Arias & Freitas 1978; Lainson et al. 1979).

Forattini (1973) treated L. elongata as a junior synonym of L. whitmani, an erroneous conclusion according to Ready Fraiha (1981) owing to differences in the lengths of the genital filaments (6X length of pump for L. elongata vs. 3-4.1 for L. whitmani). However, measurements of the filament & pump illustration (Fig. 46 of Floch & Abonnenc 1952) indicate that the filaments of L. elongata, the holotype, are but 5.1X the pump length. Our examination of the holotype of L. elongata in 1987 shed little light on its status. The genital filaments are broken, but the tips are like those of whitmani (Pl. 31-7). The head and thorax are crushed, perhaps due to remounting in 1973, and no appendages are complete.

Only this specimen of L. elongata is known and therefore if its genital filament length represents extreme variation of a L. whitmani

male then the synonym must be upheld. Additional specimens from French Guiana, at or near the type locality, are needed to definitely solve this problem.

The immature stages of L. whitmani were studied by Barretto (1941).

Lutzomyia (Nyssomyia) sylvicola (Floch & Abonnenc)

Plate 31-8

Phlebotomus sylvestris Floch & Abonnenc (not sylvestris Sinton) 1944b: 3 (♂, Saul, French Guiana).

Phlebotomus sylvicolus Floch & Abonnenc 1945d: 1 (new name for sylvestris Floch & Abonnenc).

Lutzomyia sylvicola: Barretto 1962: 98 (listed). Martins & Silva 1964: 130 (Acre, Brazil). Theodor 1965: 171 (listed). Ready & Fraiha 1981: 708 (♂ keyed, tax.). Arias & Freitas 1982: 406 (listed, Acre, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus monticolus: Forattini 1973: 474 (as senior synonym of sylvicolus Floch & Abonnenc).

Lutzomyia monticola: Leger et al. 1977: 222 (as senior synonym of sylvicolus).

Distribution (Map. 31-6). French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); ? Brazil (Martins & Silva 1964a).

Remarks. We examined the holotype of L. sylvicola (no. 516) from Saul, French Guiana through the courtesy of F. Rodhain, Institute Pasteur, Paris. The specimen was remounted in 1973; the terminalia is clearly visible and in excellent condition. The head is ruptured and palpomeres 3-5 are missing. The scutum, pronotum, and head are well pigmented, apparently unlike the male of L. sylvicola (no. 554) from French Guiana that Ready & Fraiha (1981) studied. The genital filaments, although separated from the genital pump of the holotype, are 2.41X the length of the pump, not 3 to 3.5X as stated and illustrated by Floch & Abonnenc (1944b, 1952). The filament tips are downwardly turned, difficult to observe.

It is clear the L. sylvicola is distinct from L. monticola (Costa Lima), a synonym proposed by Forattini (1973) but shown to be incorrect by Ready & Fraiha (1981). Lutzomyia hernandezi is structurally similar to L. sylvicola and may prove to be conspecific with it.

The record of L. sylvicola from Acre State, Brazil (Martins & Silva 1964a) requires confirmation.

Lutzomyia (Nyssomyia) intermedia (Lutz & Neiva)

Plate 31-9

Phlebotomus intermedius Lutz & Neiva 1912: 92 (♂, ♀ southern Brazil in States of Rio de Janeiro, São Paulo & Minas Gerais).

Phlebotomus lutzi Manson-Bahr 1925: 144 (name mentioned).

Phlebotomus neivai Pinto 1926: 371 (♂, Sao Paulo, Brazil).

Phlebotomus mazzai Paterson 1926: 305 (♂, ♀ San Pedro, Jujuy, Argentina).

Flebotomus intermedius: Barretto 1947a: 204 (full refs., synonyms).

Lutzomyia intermedia: Martins, Godoy & Silva 1961: 310 (southern Brazil). Barretto 1962: 98 (listed). Theodor 1965: 184 (♂, ♀ figs., listed). Martins et al. 1978: 99 (♂, ♀ figs., refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil). Ready & Fraiha 1981: 708 (keyed). Lima et al. 1981: 64 (Rio de Janeiro, Brazil). Rangel et al. 1984: 395 (nat. infection of Leishmania, Rio de Janeiro, Brazil). Arias et al. 1984: 326 (cf. to waltoni). Barros et al. 1985: 150 (Espirito Santo, Brazil), Rangel et al. 1985: 219 (lab rearing). Lima 1986: 102 (ecology, Brazil).

Psychodopygus intermedius: Forattini 1971a: 105 (listed); 1973: 417 (♂, ♀ figs, gen. review). Gomes et al. 1986: 280 (ecology, São Paulo, Brazil).

Distribution (Map 31-7). Brazil; Paraguay and Argentina (Martins et al. 1978).

Remarks. Females of L. intermedia are highly anthropophilic and locally common. Promastigotes, presumably Leishmania braziliensis, have been found in naturally infected L. intermedia in the States of Rio de Janeiro and São Paulo, Brazil (Forattini & Santos 1952; Forattini et al.

1972; Rangel et al. 1984). Records of this species from Venezuela (Pifano & Ortiz 1952), Colombia (Morales et al. 1969), northern Brazil (Forattini 1960), Peru (Root 1934) and French Guiana (see Floch & Abonnenc 1952) represent other Nyssomyia species, not L. intermedia (Lutz & Neiva).

Barretto (1941a) described the immature stages of this species and Carmeiro & Sherlock (1964) included the pupa in an identification key.

Lutzomyia (Nyssomyia) anduzei (Rozeboom)

Plate 31-10

Phlebotomus anduzei Rozeboom 1942: 91 (♀, Gran Sabana, Venezuela). Fairchild & Hertig 1959: 121 (Costa Rica, Panama).

Lutzomyia anduzei: Barretto 1962: 98. Theodor 1965: 184. Ward 1976: 228 (larva). Ward & Fraiha 1977: 313 (tax., ♀, figs.). Leger et al. 1977: 217 (dist., French Guiana). Arias & Freitas 1977a: 294 (nat. infections, Leishmania); 1977b: 511 (coll. data, Brazil); 1978: 391 (nat. infection Le. guyanensis). Martins et al. 1978: 95 (dist., in part). Pajot & Le Pont 1979: 37 (♂, French Guiana, figs.). Lainson et al. 1979: 240 (dissection data, Pará, Brazil). Young 1979: 160 (cf. to L. umbratilis). Le Pont et al. 1980: 133 (dissection data, French Guiana). Leger et al. 1980: 117 (French Guiana). Feliciangeli 1980: 246. Fraiha et al. 1981: 702 (cf. to L. shawi). Ready & Fraiha 1981: 708 (keyed). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Ready et al. 1983: 780 (Pará,

Brazil), Murillo & Zeledon 1985: 59 (Costa Rica). Ready et al. 1985: 27. Arias et al. 1985: 1101 (flagellate infections, Brazil). Ryan 1986: (figs., Brazil). Ready et al. 1986: 25 (NE Brazil). Lebbe et al. 1987: 29 (computer aided identification). Ryan et al. 1987a: 356 (dissection data, Brazil).

Psychodopygus anduzei: Forattini 1971a: 105; 1973: 437 (in part).

Distribution (Map 31-8). Costa Rica (Murillo & Zeledon 1987); Panama (Fairchild & Hertig 1959); Venezuela (Rozeboom 1942); French Guiana (Leger et al. 1977: Lebbe et al. 1987); Brazil (Ward & Fraiha 1977; Martins et al. 1978; in part; Ryan 1986).

Remarks. Before 1977, many citations dealing with this species in Brazil, French Guiana and Suriname referred to L. umbratilis, not L. anduzei. Ward & Fraiha (1977) discussed these misidentifications.

Three females from Panama (Almirante, Bocas del Toro Prov.) in the University of Florida collection represent the total number of specimens known from that country. They and a single female from Costa Rica (not examined) were identifies as L. anduzei (Rozeboom) by Fairchild & Hertig (1959). The Panama specimens, although heavily stained, appear to be naturally pale and the spermathecae and ducts closely resemble those of L. anduzei.

Arias & Freitas (1978) isolated Leishmania (probably Le. guyanensis) from wild-caught L. anduzei females collected near Manaus,

Brazil. Subsequent isolations of this parasite in Pará, Brazil from L. anduzei, in addition to other observations on its abundance and feeding habits, indicate that this species is a secondary vector of Le. guyanensis (Lainson et al. 1979).

## Lutzomyia (Nyssomyia) umbratilis Ward & Fraiha

Plate 31-11

Lutzomyia sp. 260.31 Fraiha et al. 1978: 136 (N. Brazil).

Lutzomyia anduzei (not P. anduzei Rozeboom): Ward & Fraiha 1977: 313 (refs.).

Lutzomyia umbratilis Ward & Fraiha 1977: 314 (♀, Rio Jari, Pará, Brazil). Arias & Freitas 1978: 391 (nat. infected with Leishmania guyanensis, Brazil). Lainson et al. 1979: 240 (nat. infected with Trypanosoma & Leishmania, Brazil). Young 1979: 160 (tax., figs., refs.). Pajot & Le Pont 1979: 38 (cf. to anduzei). Leger et al 1980: 116 (French Guiana). Le Pont & Pajot 1980: 641 (nat. infection rates, Leishmania guyanensis, French Guiana). Fraiha et al. 1980a: 21 (Peru). Le Pont et al. 1980: 133 (nat. infected with Leishmania guyanensis, French Guiana). Morales & Minter 1981: 96 (Colombia). Ready & Fraiha 1981: 709 (keyed). Fraiha et al. 1981: 702 (cf. to Shawi). Lewis & Macfarlane 1981: 181 (mite parasites, Brazil). Le Pont 1982: 269 (seasonal dist., French Guiana). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Travassos da Rosa et al. 1983: 1166 (Munguba virus). Ready et al. 1983: 780 (Pará, Brazil). Hudson & Young 1985: 418 (Suriname). Feliciangeli et al. 1985: 878 (Venezuela). Ready

et al. 1985: 27 (control trials, Brazil). Esterre et al. 1986: 559 (control program, French Guiana). Geoffroy et al. 1986: 486 (resting site study, French Guiana). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 68 (♂, ♀ figs., dist.). Ready et al. 1986: 21 (Ecology, Pará, Brazil). Killick-Kendrick 1986: 135 (listed). Ryan et al. 1987: 356 (dissection results, flagellates, Brazil). Lebbe et al. 1987: 29 (computer aided identification). Young et al. 1987: 589 (nat. infection of Le. guyanensis, Colombia).

Distribution (Map 31-9). Venezuela (Felicingeli et al. 1985); Colombia (Young 1979; Morales & Minter 1981); Suriname (Hudson & Young 1985); French Guiana (Floch & Abonnenc 1952, as anduzei; Geoffroy 1986; other refs. listed above); Brazil (Arias & Freitas 1978, 1982; Biancardi et al. 1982; Ready et al. 1986; Ryan 1986); Peru (Fraiha et al. 1980a); Bolivia (Le Pont & Desjeux 1986).

Remarks. Lutzomyia umbratilis is a proven, and seemingly the most important vector, of Leishmania guyanensis to man in French Guiana, Northern Brazil and probably elsewhere in Amazonia (see Young & Lawyer 1985 for references). Munguba Phlebovirus was isolated from pools of L. umbratilis collected at Monte Dourado, Jari, Pará, Brazil (Travassos et al. 1983).

The ecology of this species has been well studied in French Guiana and northern Brazil.

Lutzomyia (Nyssomyia) edentula (de Leon)

Plate 31-12

Phlebotomus edentulous Leon 1971: 192 (♀, probably El Chaguiton, Esquipulas, Guatemala). Martins et al. 1978: 168 (as inadequately described species).

Lutzomyia edentula: Murillo & Zeledon 1985: 59 (♂, ♀ figs., dist. Costa Rica.

Distribution (Map 31-7). Guatemala (Leon 1971; 16 Montana del Mico, Rio Blanco, human bait, J. Boshell; o topotypes, C..H. Porter). Honduras (15 ♀♀, Tela, Lancetilla Valley, W. Hils); Costa Rica (Murillo & Zeledon 1985; 2 ♀♀, Moravia, Chirripo, Shannon trap, R. Zeledon); Panama (9 ♀♀, El Volcan de Chiriqui, Chiriqui, light traps, F.B. Blanton; 1 ♂ , 1 ♀, Palo Santo, Chiriqui, biting man & tree trunk, R. Hartmann; 1 ♀, La Tula, Chiriqui, biting man, R. Hartmann; 1 ♀, Santa Clara, Chiriqui, Shannon trap, R. Hartmann.

Remarks. Through the courtesy of C.H. Porter, we studied two females of L. edentula (slides 697 & 963a) from Leon's collection. These specimens were those that Leon (1971) described and illustrated but neither was given type status. Both were captured at El Chaguiton, Esquipulas, Guatemala by Leon on 5 May 1970. We designate slide 963a as the lectotype.

The female of L. edentula, in contrast to Leon's original description, has well defined horizontal teeth in the cibarium (Murillo

& Zeledon 1985 and Plate 31-12 of present review). Both sexes differ from those of L. ylephiletor and L. trapidoi by their heavily infuscated pronotum that is pale in the latter two species. In addition, the female of L. edentula has widely tapered individual ducts & wide common duct.

After discovering that L. edentula was structurally close to these two other species, we re-examined slide material in the collection at the University of Florida. Two of the L. ylephiletor paratypes (♂ slide no. 2953, Palo Santo, Panama & ♀ slide no. 2271, La Tula, Panama) represent not that species but L. edentula.

Females of L. edentula are anthropophilic and probably, locally common. The species has been captured with L. trapidoi and L. ylephiletor at Tello, Honduras and solely from higher elevations in Chiriqui Prov., Panama (ca. 1600 m above sea level).

Lutzomyia (Nyssomyia) trapidoi (Fairchild & Hertig)

Plate 31-13

Phlebotomus trapidoi Fairchild & Hertig 1952: 524 (♂, ♀, Almirante, Bocas de Toro, Panama).

Lutzomyia trapidoi: Barretto 1962: 98 (listed). Martins et al. 1978: 102 (refs., dist.). Young 1979: 157 (refs., figs., dist.). Christensen & Herrer 1980b: 523 (feeding habits). Porter & De Foliart 1981: 81 (ecology, Colombia). Ready & Fraiha 1981: 708 (keyed). Morales et al.

1981: 198 (♀ figs., nat. infected with Leishmania panamensis, see Young et al. 1987). Chaniotis et al. 1982: 3 (pilot control trial, Panama). Zeledon & Murillo 1983: 280 (Nicaragua). Young & Rogers 1984: 605 (Ecuador). Arias et al. 1984: 326 (cf. to waltoni). Murillo & Zeledon 1985: 52 (♂, ♀ figs., dist. Costa Rica). Hashiguchi et al. 1985a: 440 (nat. Leishmania infections, Ecuador); 1985b: 533 (biting activity, Ecuador). Chaniotis 1986: 163 (lab rearing). Young et al. 1987: 589 (nat. infections of Leishmania panamensis, Colombia).

Psychodopygus trapidoi: Forattini 1971a: 105 (listed); 1973: 123 (figs., refs., gen. review).

Distribution (Map 31-4). Honduras (Fairchild & Hertig 1959); Nicaragua (Zeledon & Murillo 1983); Costa Rica (Murillo & Zeledon 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Morales et al. 1981); Ecuador (Young 1979).

Remarks. Other references pertaining to L. trapidoi and written before 1978 are given by Young (1979).

Lutzomyia trapidoi is a putative vector of Leishmania panamensis in Panama, Colombia and possibly Ecuador (see Young & Lawyer 1987 for specific references). Tesh et al. (1974) isolated certain arboviruses from pools of female and male L. trapidoi in Panama.

Specimens of this species from the Pacific Coast region of Colombia, notably in Valle Department, and in Pichincha Prov., Ecuador

are darker than elsewhere. Recent isozyme comparisons between these populations (R. Kreutzer, pers. comm.) suggest they may not be conspecific. The dark form may have been misidentified as L. ylephiletor by Arzube (1960).

Lutzomyia (Nyssomyia) ylephiletor (Fairchild & Hertig)

Plate 31-14

Phlebotomus ylephiletor Fairchild & Hertig 1952: 520 (♂, Almirante, Bocas del Toro, Panama; ♀, Cacique, Colon, Panama); 1959: 122 (dist.).

Phlebotomus olmecus Vargas & Najera 1959: 147 (in part, ♀ only).

Lutzomyia ylephiletor (or ylephiletrix): Barretto 1962: 98 (listed). Theodor 1965: 184. Martins et al. 1978: 104 (refs., dist.). Young 1979: 162 (refs., figs., dist.). Ready & Fraiha 1981: 709 (keyed). Zeledon et al. 1982: 276 (Honduras). Christensen et al. 1983: 466 (rel. abundance, Panama). Arias et al. 1984: 326 (cf. to waltoni). Murillo & Zeledon 1985: 55 (♂, ♀, figs, dist., Costa Rica). Killick-Kendrick 1986: 135 (listed). Porter et al. 1987: 929 (nat. infection of Leishmania mexicana, Guatemala).

Psychodopygus ylephiletor: Forattini 1971a: 106 (listed); 1973: 123 (figs., dist., tax.).

Distribution (Map 31-6). Mexico (Vargas & Najera 1953b; Fairchild & Hertig 1959); Belize (Williams 1970; Martins et al. 1978); Guatemala (Porter et

al. 1987); Honduras (Fairchild & Hertig 1959; Zeledon et al. 1982); Nicaragua (Fairchild & Hertig 1959); Costa Rica (Murillo & Zeledon 1985); Panama (Martins et al. 1978); Colombia (Young 1979).

Remarks. The recent discovery of Leishmania mexicana in a naturally infected female of L. ylephiletor from Guatemala (Porter et al. 1987) represents the first isolation of this parasite from a sand fly other than L. o. olmeca and indicates that more studies are needed to clarify the epidemiology of citaneous leishmaniasis caused by Leishmania mexicana in Guatemala. Lutzomyia ylephiletor is one of the suspected vectors of L. panamensis in Panama (Christenson & Herrer 1973) and in Costa Rica (Zeledon 1985).

Lutzomyia (Nyssomyia) yuilli yuilli Young & Porter

Plate 31-15

Lutzomyia yuilli Young & Porter 1972: 524 (♂, ♀, Rio Anori, Antioquia, Colombia). Ward & Ready 1975: 128 (egg). Llanos et al. 1975b: 669 (Peru). Lainson et al. 1976: 57 (nat. flagellate infection, Mato Grosso, Brazil). Martins et al. 1978: 104 (dist., refs.). Fraiha et al. 1978: 136 (n. Brazil). Abonnenc et al. 1979: 75 (cf. to L. yuilli pajoti). Young 1979: 164 (tax. review, refs). Fraiha et al. 1980b: 21 (Peru). Lewis & Macfarlane 1981: 708 (keyed). Ready & Fraiha 1981: 708 (keyed). Porter 1981: 81 (man biting habits, Colombia). Morales & Minter 1981: 96 (Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Llanos 1981: 183. Young & Rogers 1984: 599 (Ecuador). Young et al. 1985: 143 (Peru). Arias et al. 1985: 1101 (nat. flagellate

infections, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 71 (♂ , ♀, figs., Pará, Brazil). Vexenat et al. 1986b: 295 (Bahia, Brazil, = L. fraihai).

Lutzomyia antunesi (not P. antunesi Coutinho): Llanos 1973: 42 (♀ figs., Peru).

Lutzomyia fraihai: Martins, Falcao & Silva 1979a: 357 (♂ , ♀, Tres Bracos, Bahia, Brazil). Fraiha et al. 1981: 702 (cf. to shawi).

Distribution (Map 31-10). Colombia (Young 1979; Morales & Minter 1981); Ecuador (Young 1979); Peru (Fraiha et al. 1980a; Llanos 1983; Young et al. 1985); Brazil (Lainson et al. 1976; Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); Bolivia (Le Pont & Desjeux 1986).

Remarks. A pale sand fly, L. y. yuilli is widespread, but locally common, in forests in South America. Flagellates found in naturally infected females in Brazil (Lainson et al. 1976; Arias et al. 1985) have not been identified with certainty.

Ward & Ready (1975) illustrated (SEM micrograph) the egg surface structure of L. y. yuilli

Lutzomyia (Nyssomyia) yuilli pajoti Abonnenc, Leger & Fauran

Plate 31-15

Phlebotomus sp. de Souvenir, Floch & Abonnenc 1944d: 9 (♀, Souvenir, Haute-Mana, French Guiana)

Lutzomyia yuilli pajoti Abonnenc, Leger & Fauran 1979: (♂ , ♀, Saul, French Guiana). Leger et al. 1980: 116 (French Guiana). Ready & Fraiha 1981: 708 (keyed). Ready et al. 1983: 780 (N. Brazil). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 25 (N. Brazil). Ryan 1986: 70 (♂ , ♀, figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided identification).

Distribution (Map 31-10). French Guiana (Floch & Abonnenc 1944d; Abonnenc et al. 1979; Leger et al 1980); Suriname (Hudson & Young 1985); Brazil (Ryan 1986); Peru (♂♂ , ♀♀, near Iquitos, Loreto).

Remarks. Leger et al (1980) captured females of L. y. pajoti on human bait in French Guiana. One of us (D.Y.) recently identified males and females from northern Peru collected by E. Rogers & R. Falcon who will give specific information in a forthcoming paper. The nominate subspecies was taken near the same locality, indicating that L. y. pajoti should be treated as a full species.

## Lutzomyia (Nyssomyia) waltoni Arias, Freitas & Barrett

Plate 31-16

Lutzomyia waltoni Arias, Freitas & Barrett 1984: 325 (♂ , ♀, near Ji-Paraná, Rondonia, Brazil).

Distribution (Map 31-4). Brazil (Arias et al. 1984).

Remarks. This pale species is readily identified by the relatively long palpomere 5 and sexual character states (Arias et al. 1984).

Lutzomyia (Nyssomyia) richardwardi Ready & Fraiha

Plate 31-17

Lutzomyia sp. 260.44 Ward & Ready 1975: 128 (egg descript.). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (coll. data, Brazil).

Lutzomyia richardwardi Ready & Fraiha 1981: 705 (♂, ♀, Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Young et al 1985: 143 (Madre de Dios, Brazil). Ryan et al 1986: 66 (♂, ♀, figs., dist., Pará, Brazil). Young & Morales 1987: 664 (Meta, Colombia).

Distribution (Map 31-7). Brazil (Lainson et al 1976; Fraiha et al 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986); Peru (Young et al. 1985); Colombia (Young & Morales 1987).

Remarks. The males of L. richardwardi and L. shawi are distinguished by the distribution of pigmentation of the thorax (see keys). Males from the Tambopata Reserve, Madre de Dios, Peru (Young et al. 1985) were provisionally identified as L. richardwardi but we are now confident of these determinations.

Lutzomyia (Nyssomyia) shawi Fraiha, Ward & Ready

Plate 31-17

Lutzomyia sp. 260.43 Ward & Ready 1975: 128 (egg descript.). Fraiha et al. 1978: 136 (coll. data, Brazil).

Lutzomyia shawi Fraiha, Ward & Ready 1981: 699 (♂, ♀, Serra dos Carajas, Pará, Brazil). Ready & Fraiha 1981: 708 (keyed). Ryan 1986: 67 (♂, ♀ figs., dist. Pará, Brazil). Le Pont & Desjeux 1986: 314 (nat. flagellate infections, Bolivia). Ryan et al. 1987a: 356 (nat. Leishmania infections, Brazil).

Distribution (Map 31-11). Brazil (Fraiha et al. 1981; Ryan 1986). Bolivia (Le Pont & Desjeux 1986); Peru (Young et al. 1985).

Remarks. In Bolivia, Le Pont & Desjeux (1986) found peripylarian flagellate infections in several sand flies including four, identified as a species near L. shawi. Parasites from one of these sand flies, at least, was presumed to be Leishmania based on symptoms exhibited by an inoculated hamster. Ryan et al. (1987b) identified Leishmania, isolated from L. shawi in Brazil, as Leishmania braziliensis spp.

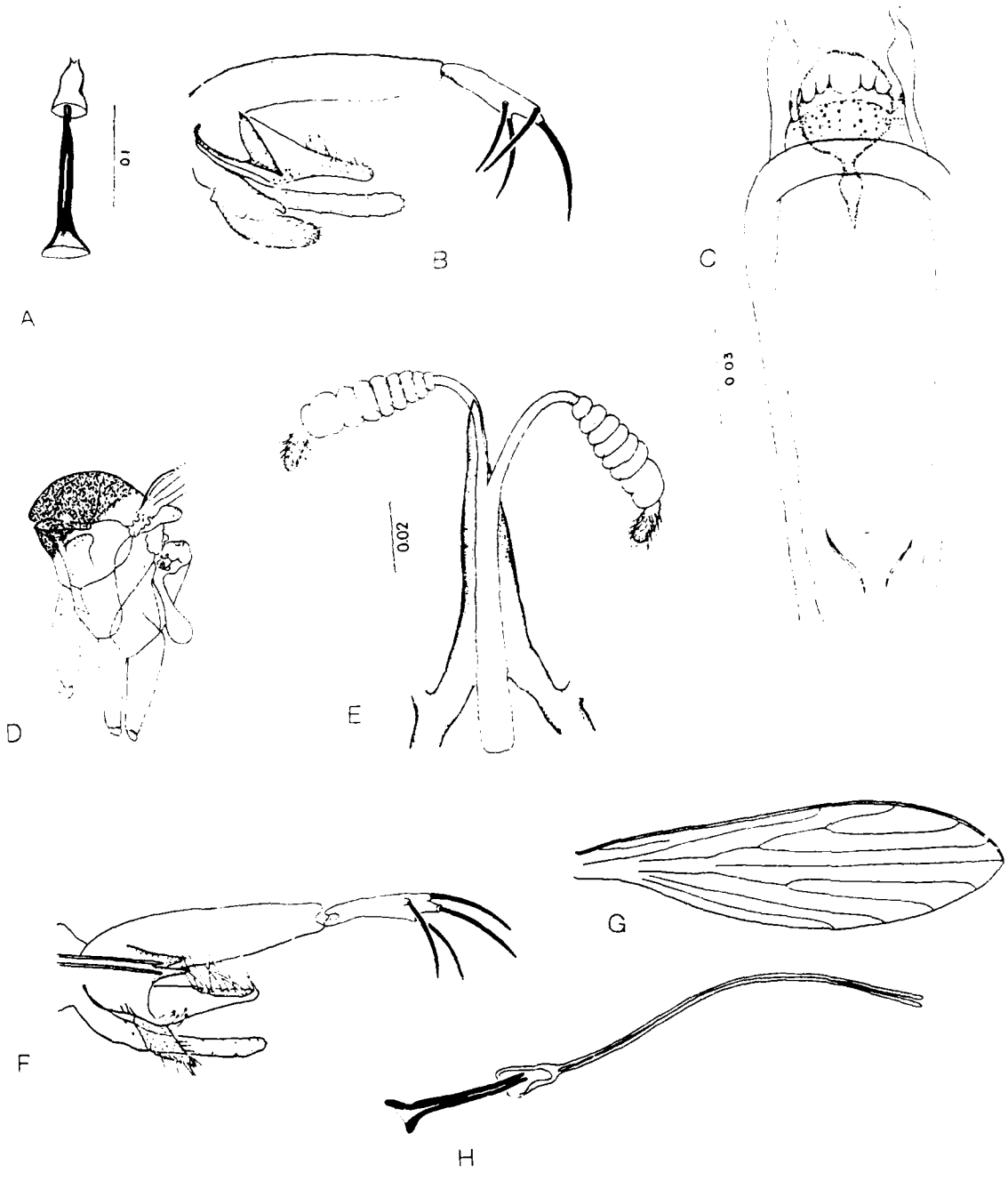



Plate 31-1

Lutzomyia flaviscutellata A. Genital pump, same scale as B; B. Male terminalia; C. Female cibarium; D. Thorax; E. Spermathecae (fig. E from Young & Arias 1982).

Lutzomyia inornata. F. Male terminalia; G. Male wing; H. Genital pump & filaments (all figs. from Martins et al. 1965).

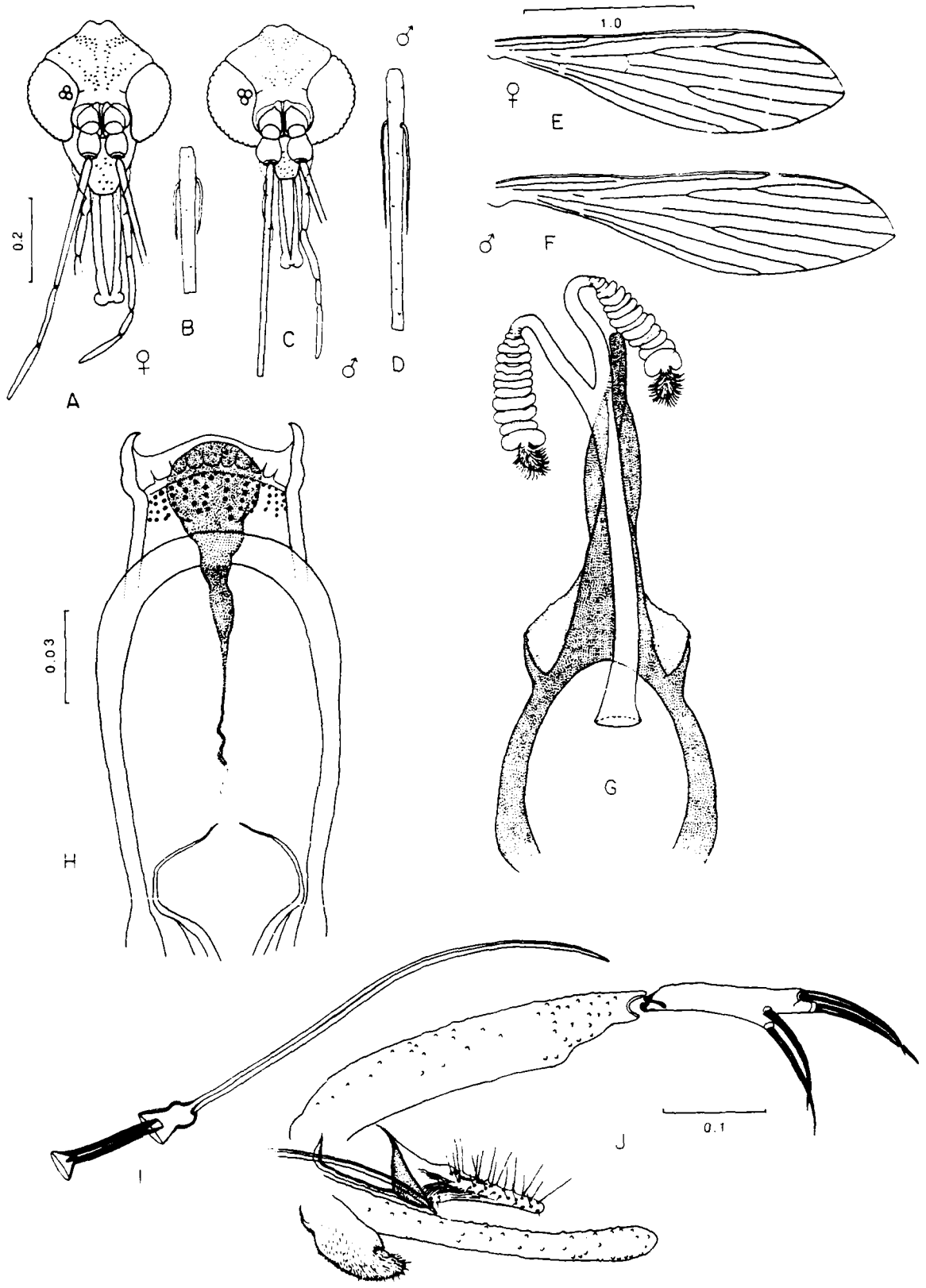



Plate 31-2

Lutzomyia olmeca olmeca. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female cibarium; I. Genital pump & filaments; J. Male terminalia.

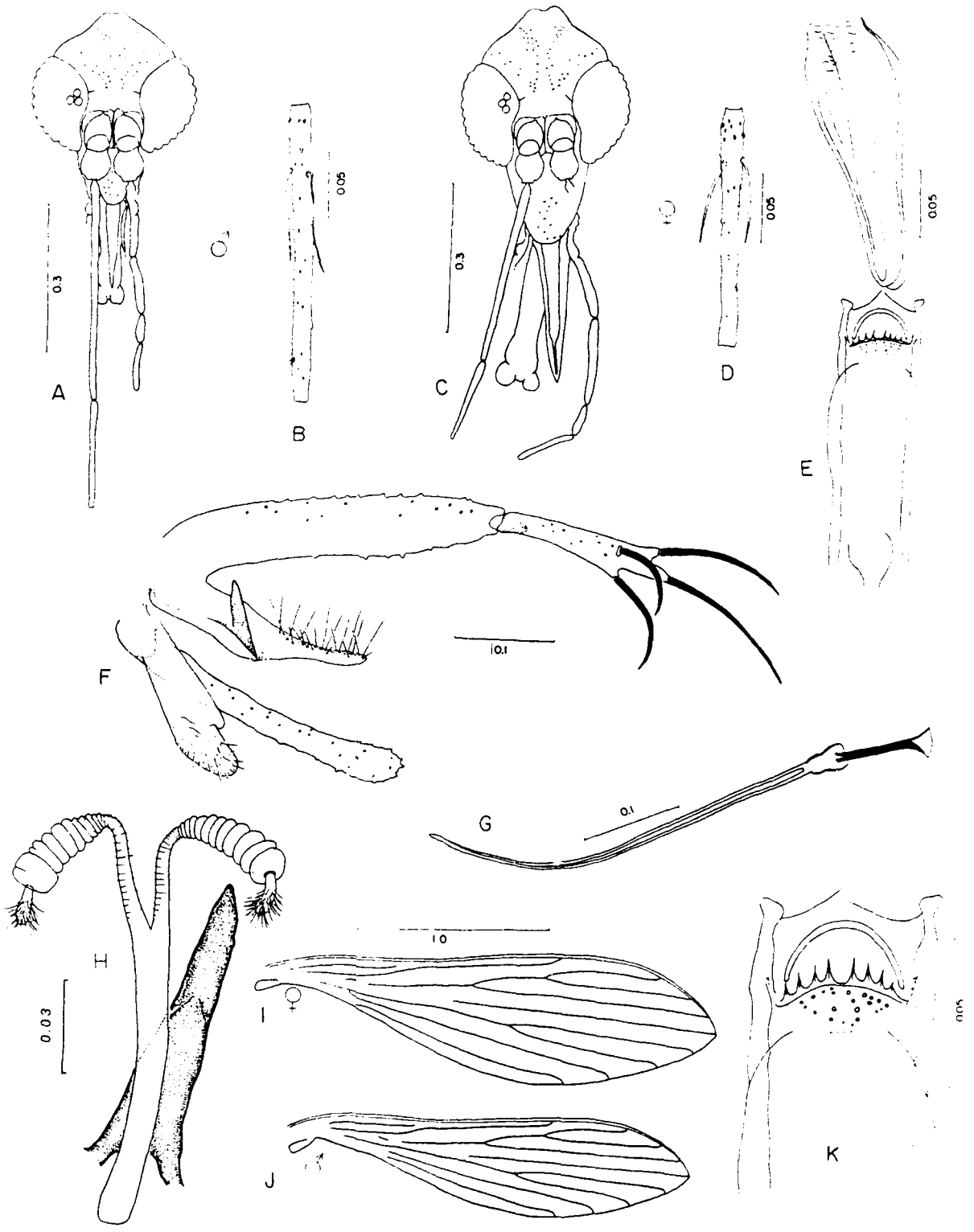



Plate 31-3

Lutzomyia olmeca bicolor. A. Male head; B. Male flagellomere II; C. Female head; D. female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (fig. H from Young & Arias 1982; others from Young 1979).

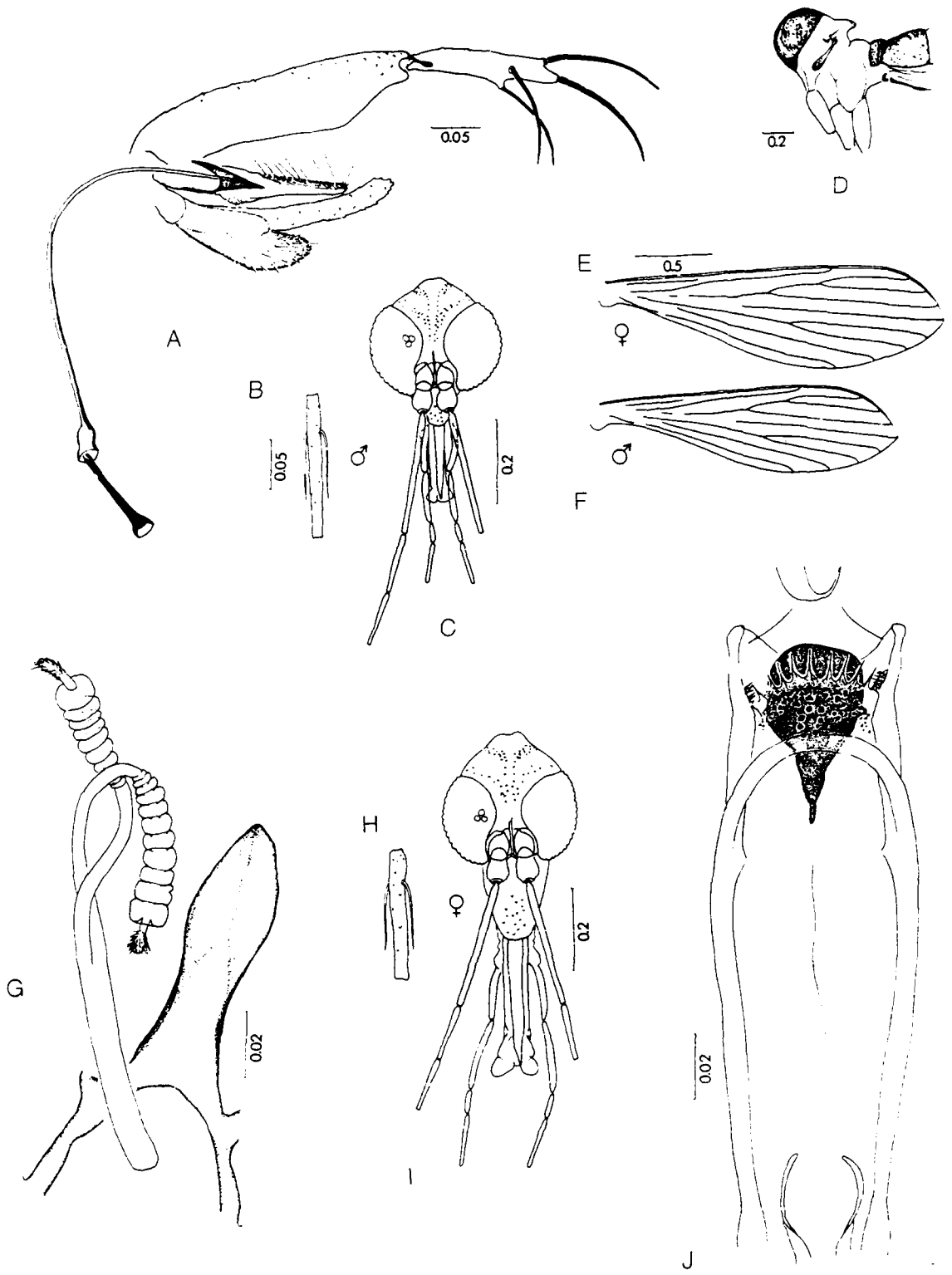



Plate 31-4

Lutzomyia olmeca nociva. A. Male terminalia; B. Male flagellomere II; C. Male head; D. Thorax & proximal part of abdomen; E. Female wing; F. Male wing; G. Spermathecae; H. Female flagellomere II; I. Female head; J. Female cibarium (all figs. from Young & Arias 1982).

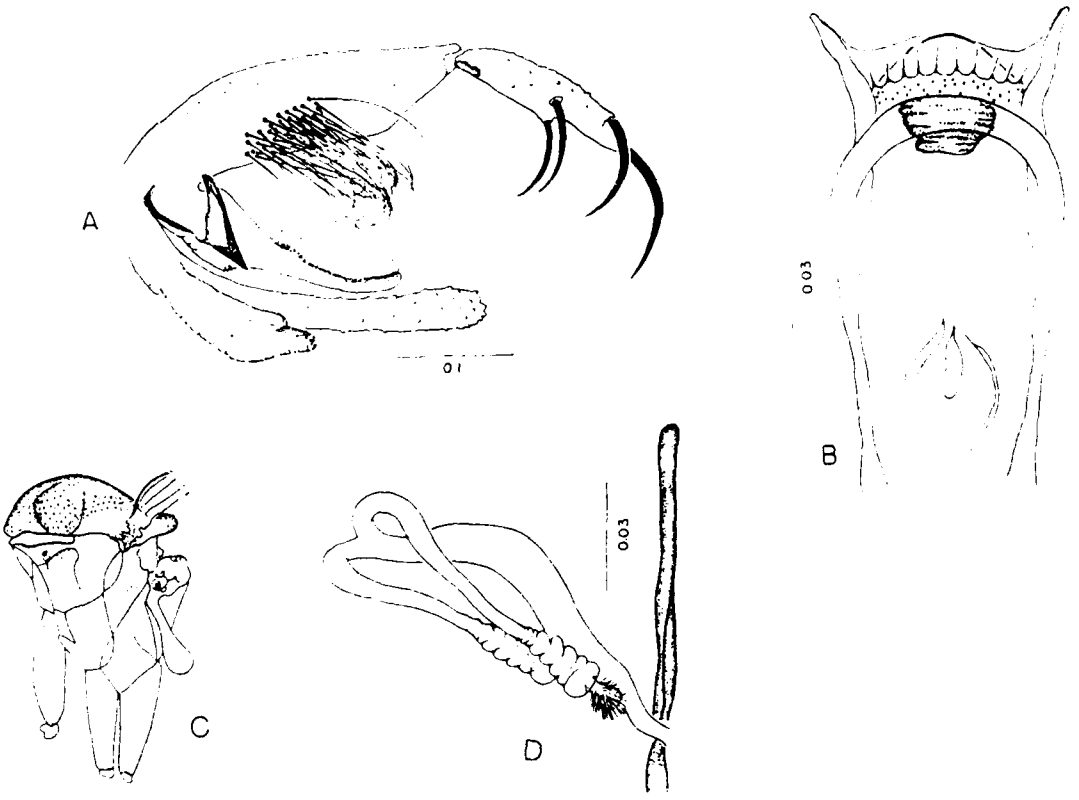



Plate 31-5

Lutzomyia antunesi. A. Male terminalia; B. Female cibarium; C. Thorax; D. Spermathecae (all figs. except C from Young 1979).

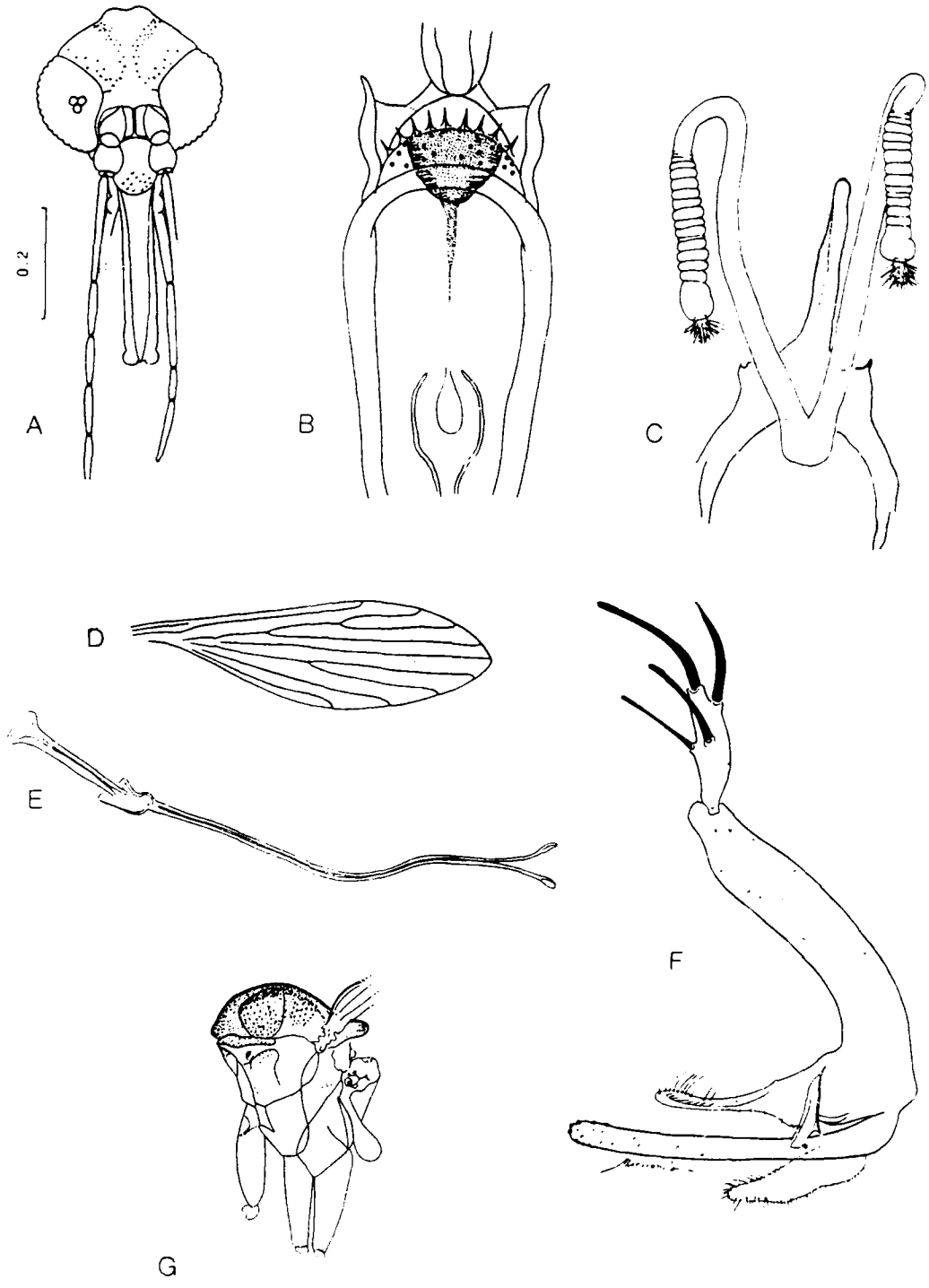



Plate 31-6

Lutzomyia hernandezi. A. Female head; B. Female cibarium; C. Spermathecae; D. Male wing; E. Gential pump & filaments; F. Male terminalia; G. Female thorax (male figs. from Ramirez Perez et al. 1979).

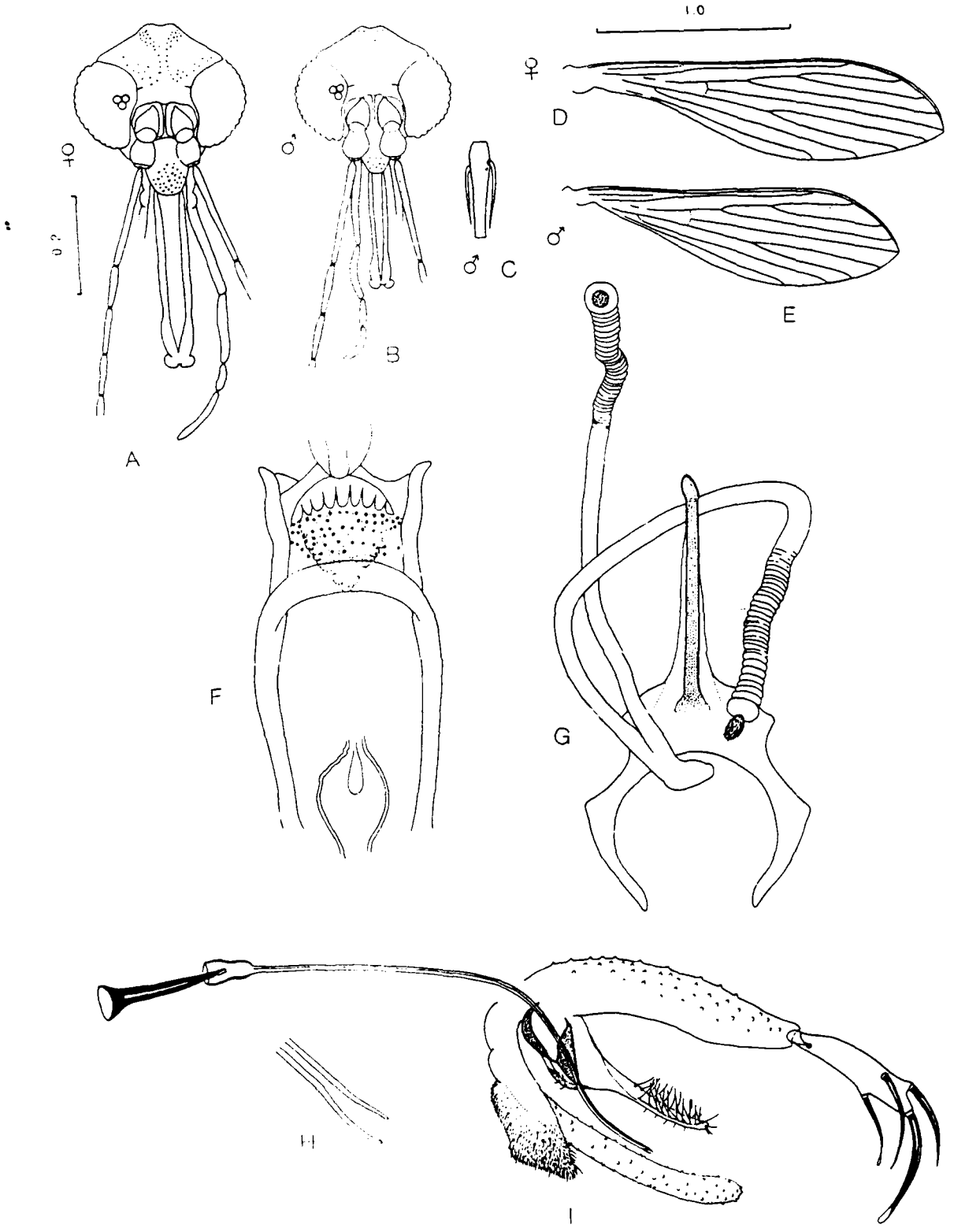



Plate 31-7

Lutzomyia whitmani. A. Female head; B. Male head; C. Male flagellomere II; D. Female wing; E. Male wing; F. Female cibarium; G. Spermathecae; H. Tip of genital filament; I. Male terminalia.

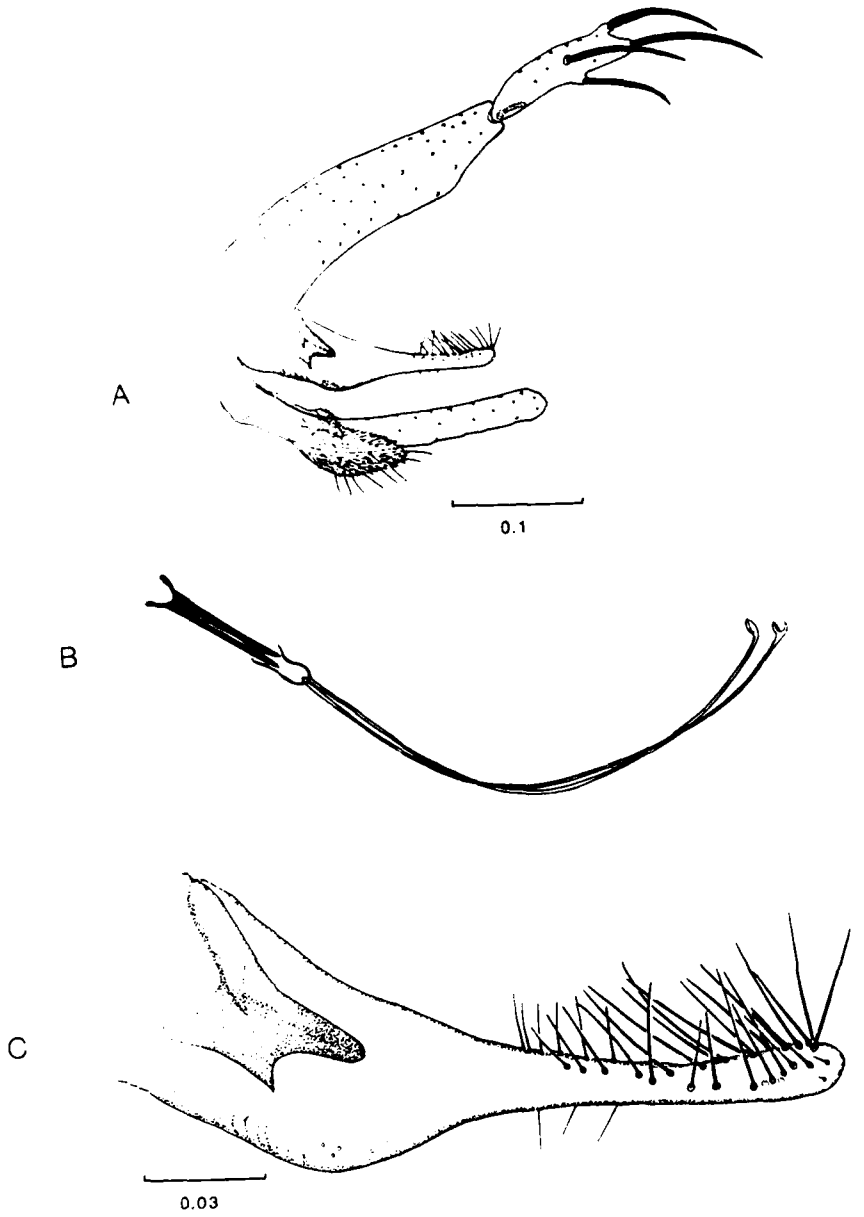



Plate 31-8

Lutzomyia sylvicola. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

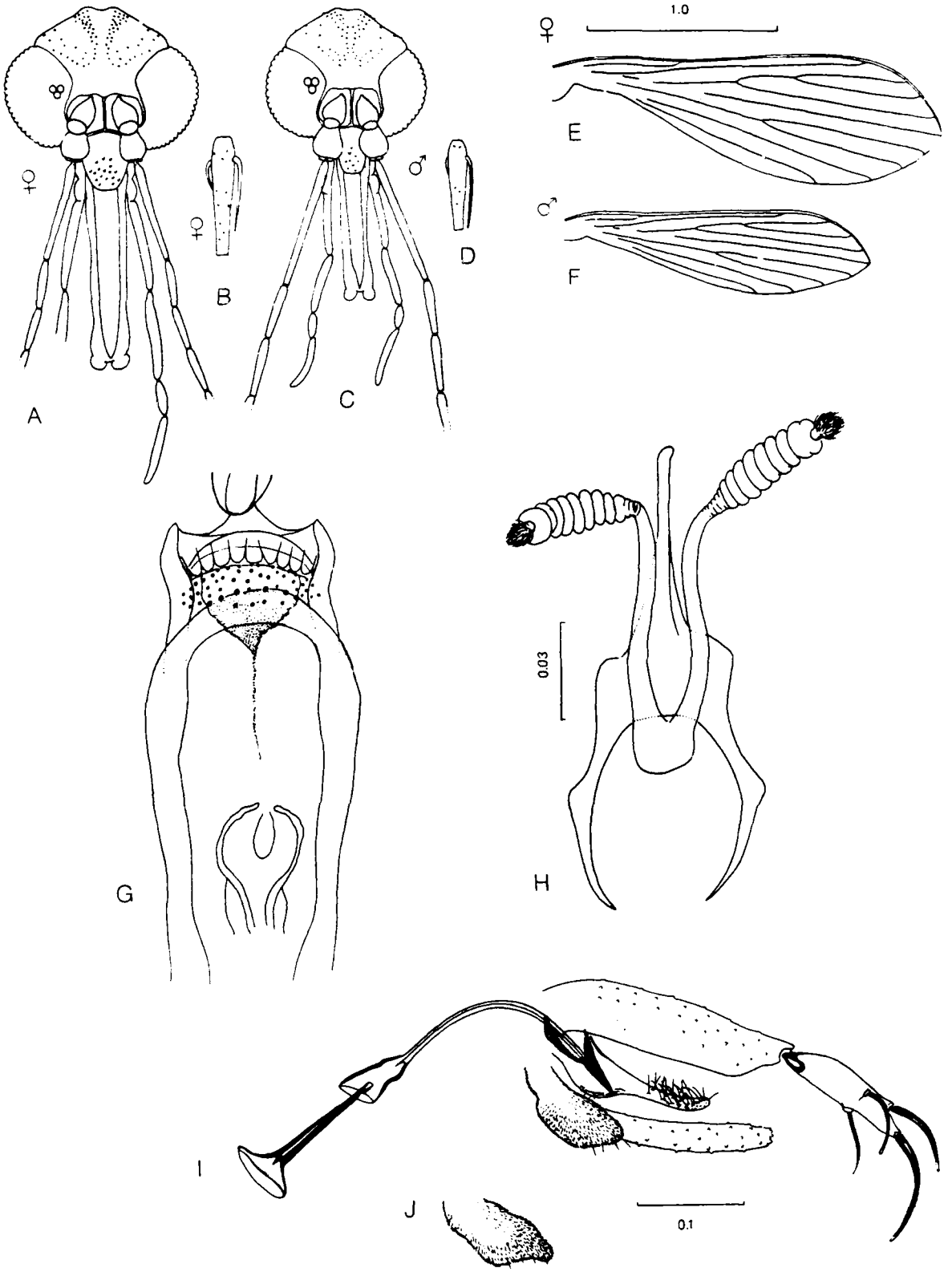



Plate 31-9

Lutzomyia intermedia. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Female cibarium; H. Spermathecae; I. Male terminalia; J. Cercus.

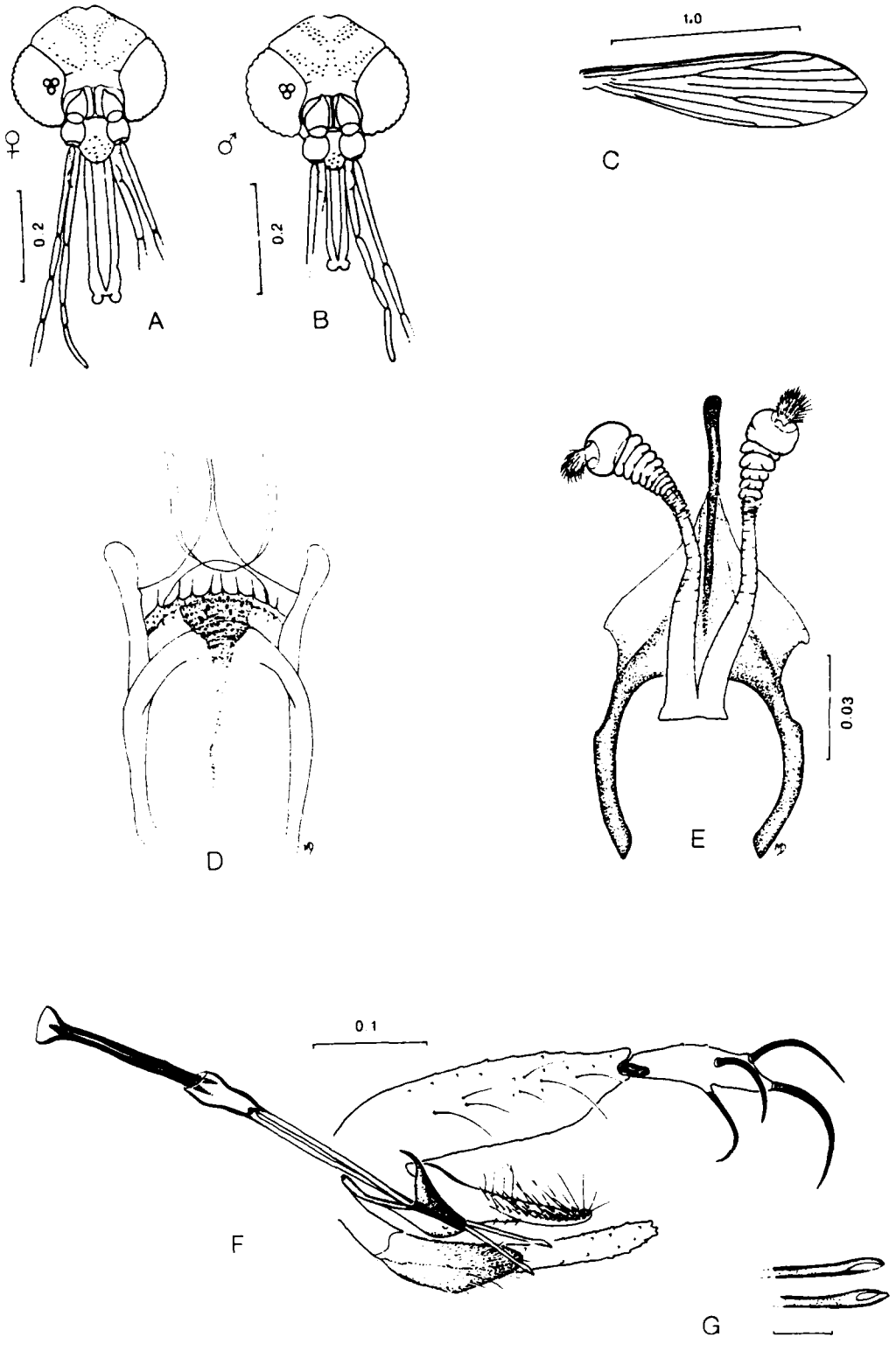



Plate 31-10

Lutzomyia anduzei. A. Female head; B. Male head; C. Male wing; D. Female cibarium; E. Spermathecae; F. Male terminalia; G. Tips of genital filaments.

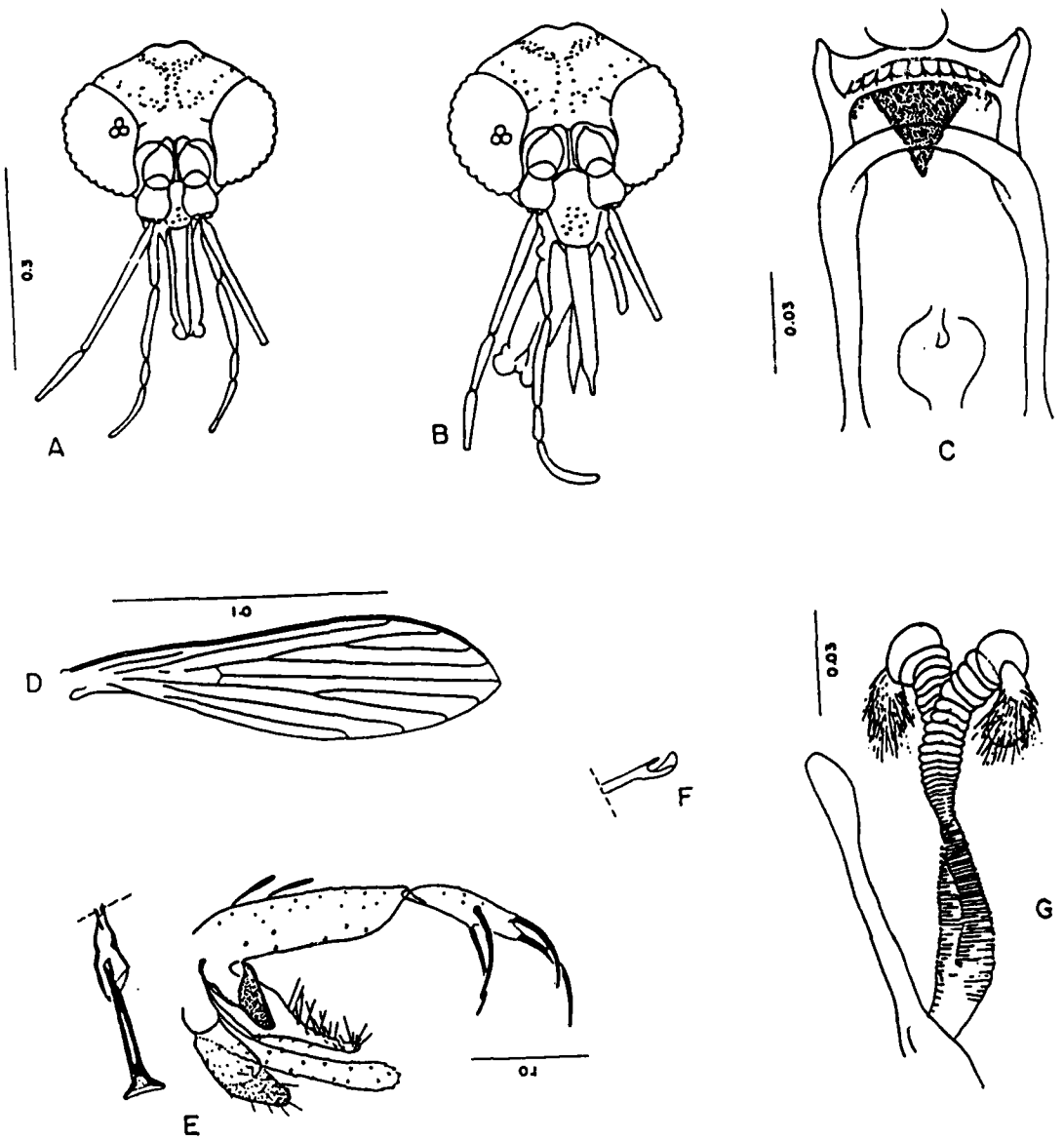



Plate 31-11

Lutzomyia umbratilis. A. Male head; B. Female head; C. Female cibarium; D. Female wing; E. Male terminalia with genital pump, same scale; F. Tip of genital filament; G. Spermathecae (from Young 1979).

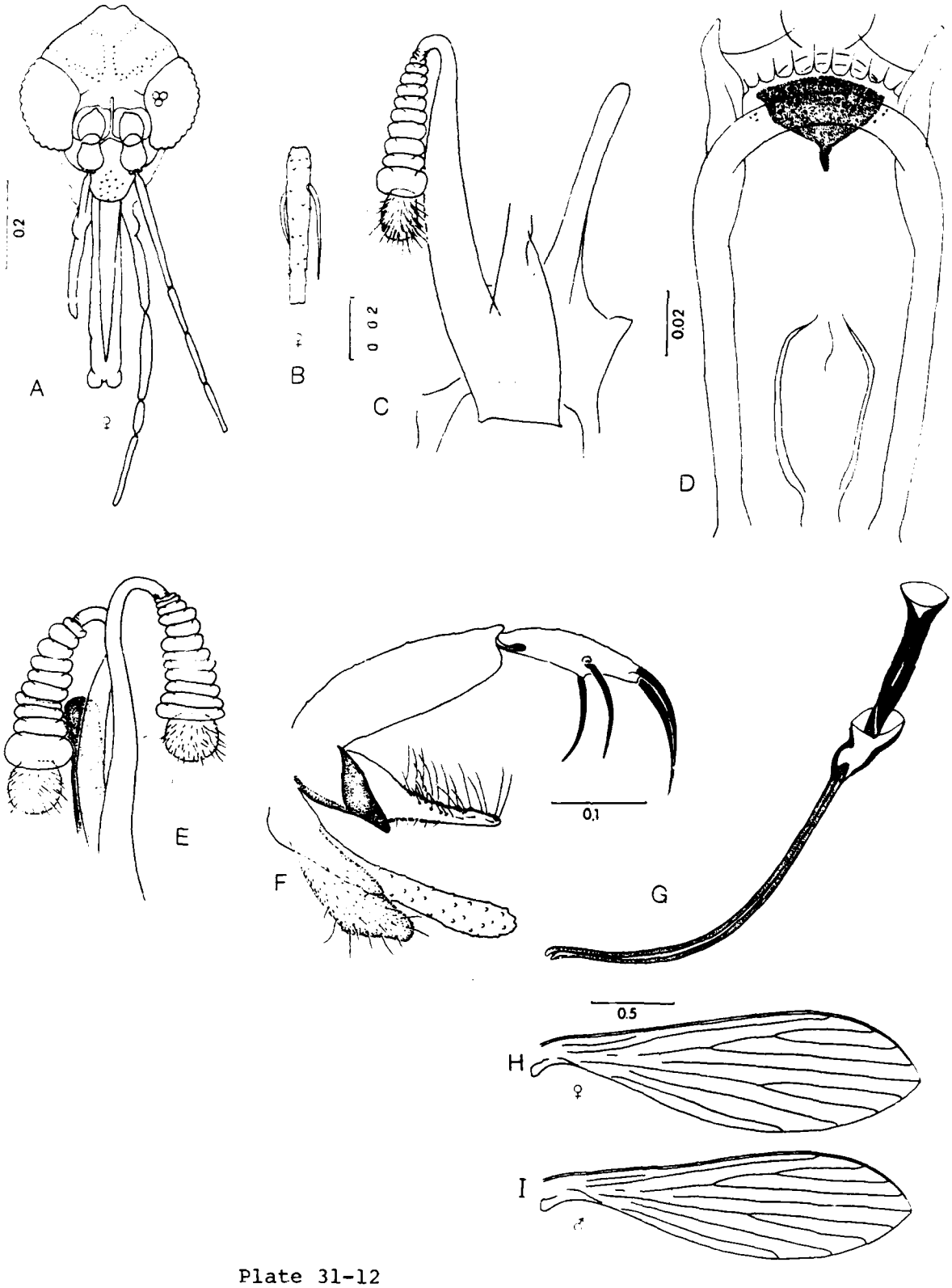



Plate 31-12

Lutzomyia edentula. A. Female head; B. Female flagellomere II; C. Spermatheca; D. Female cibarium; E. Spermathecae, from type specimen; F. Male terminalia; G. Genital pump & filaments; H. Female wing; I. Male wing.

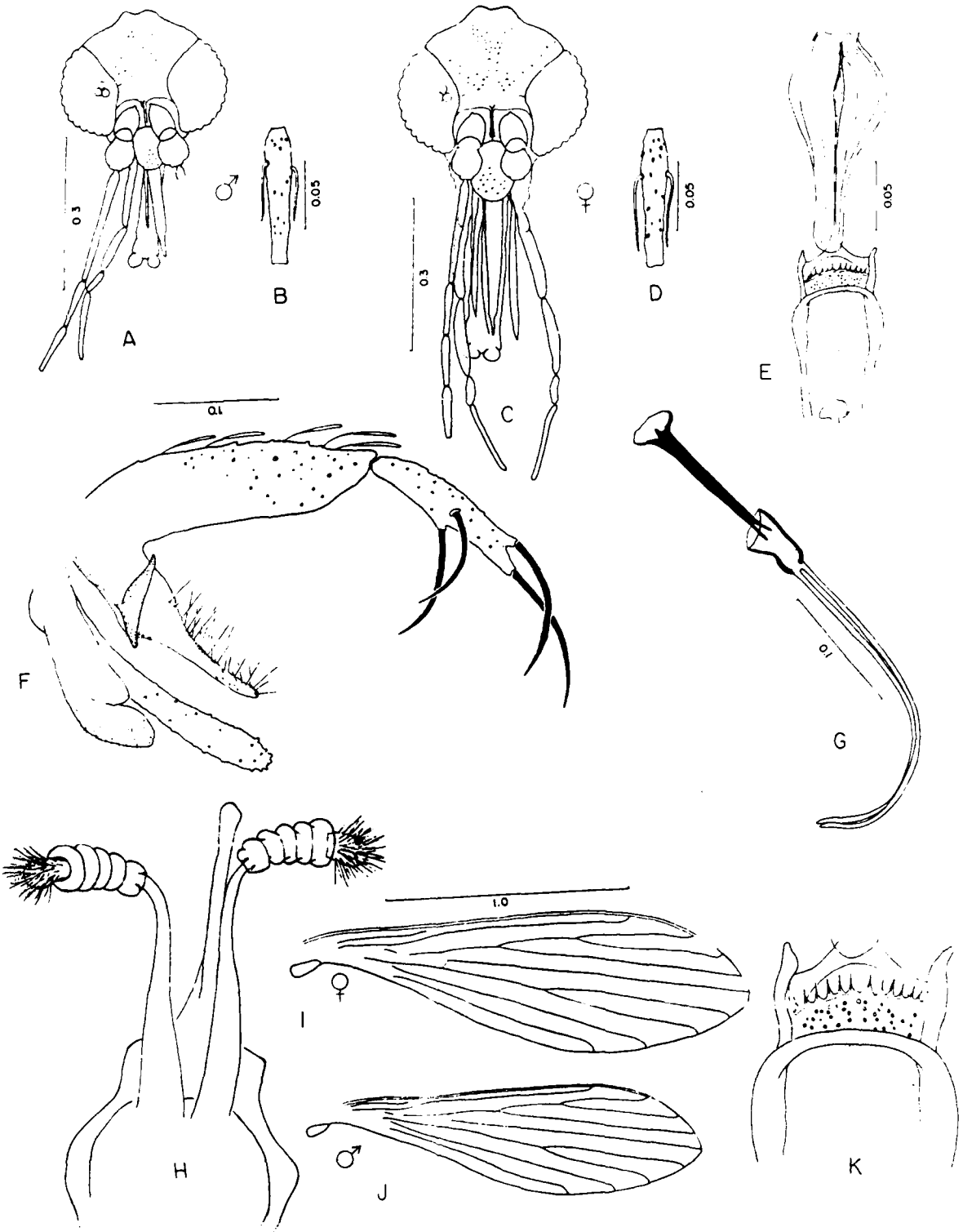



Plate 31-13

Lutzomyia trapidoi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (all figs. except H from Young 1979).

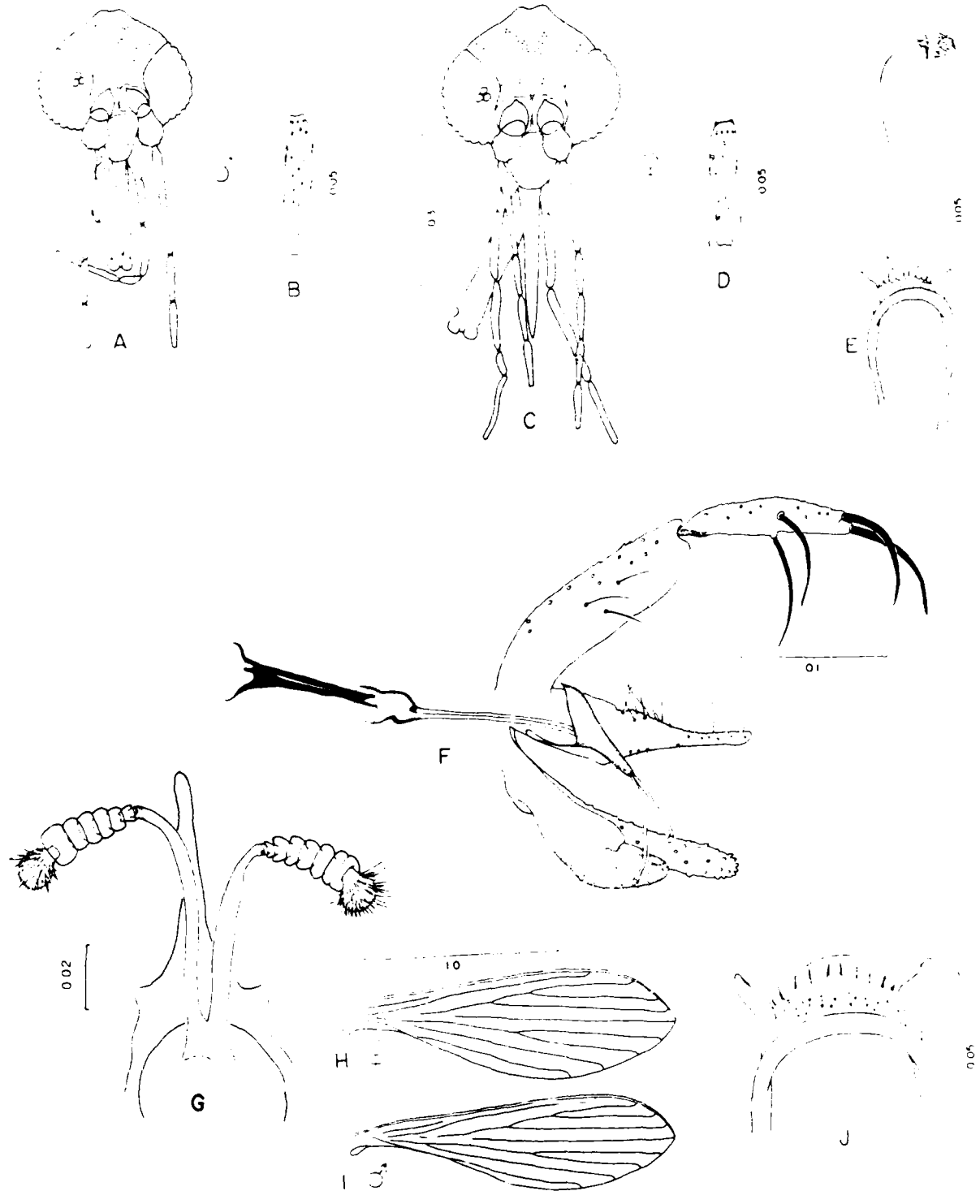



Plate 31-14

Lutzomyia ylephiletor. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermathecae; H. Female wing; I. Male wing; J. Female cibarium (all figs. except G from Young 1979).

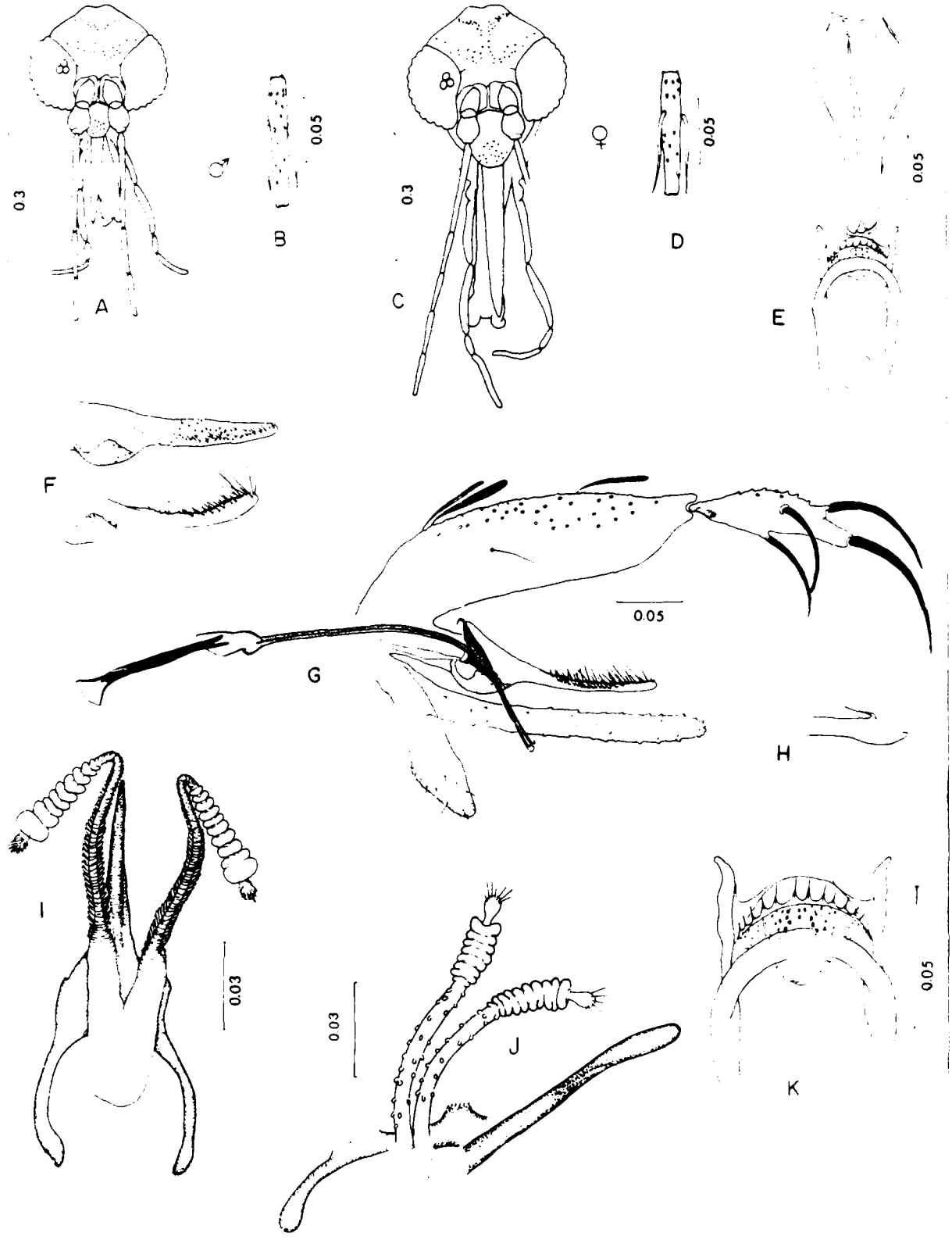



Plate 31-15

Lutzomyia yuilli yuilli. A. Male head; B. Male flagellomere II; C. Female head; D. Female glagellomere II; E. Female cibarium & pharynx; F. Parameres; G. Male terminalia; H. Tip of genital filament; I. Spermathecae; K. Female cibarium (all figs. from Young & Porter 1972).

Lutzomyia yuilli pajoti. J. Spermathecae.

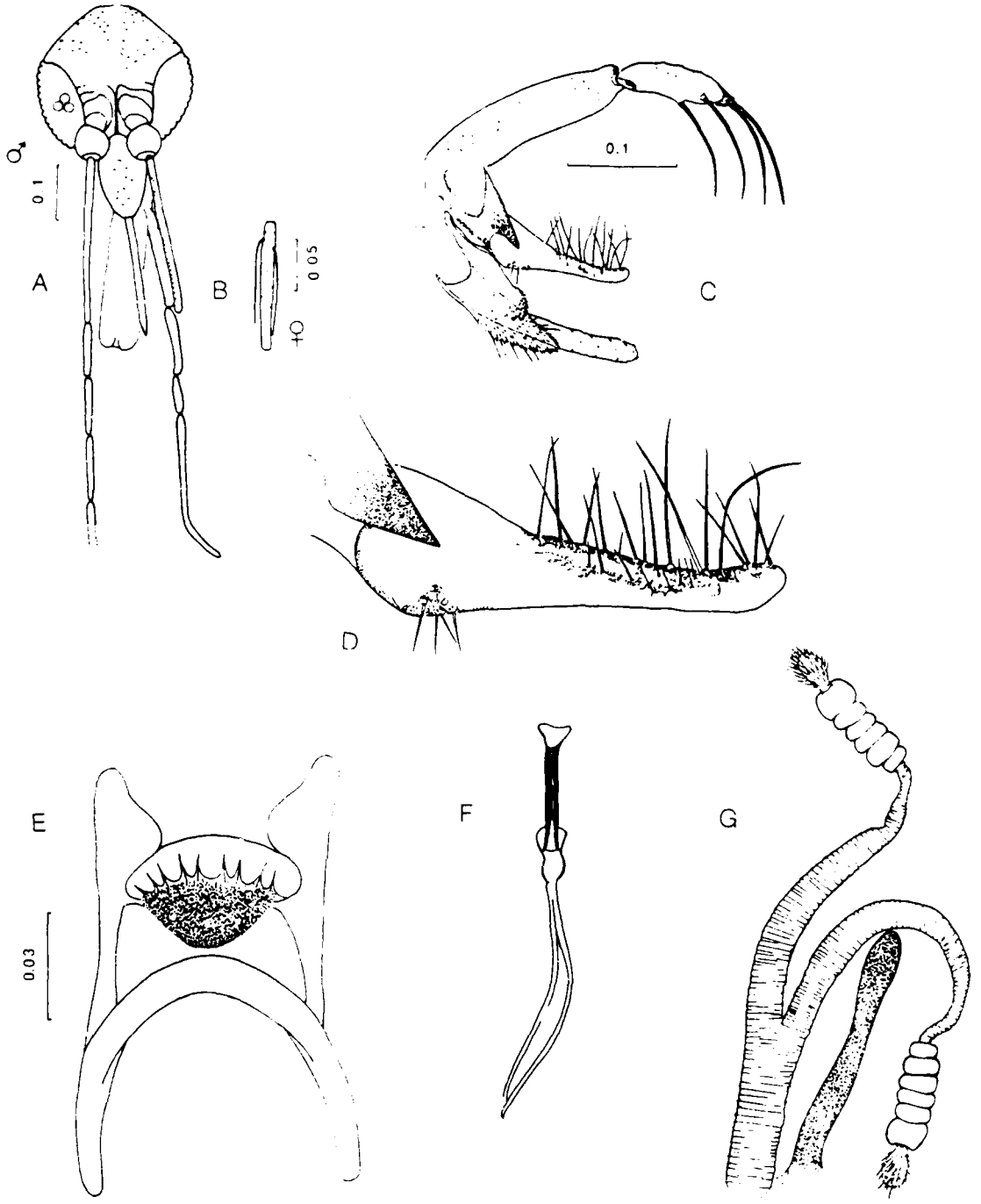



Plate 31-16

Lutzomyia waltoni. A. Male head; B. Female flagellomere II; C. Male terminalia; D. Paramere; E. Female cibarium; F. Genital pump & filaments; G. Spermathecae.

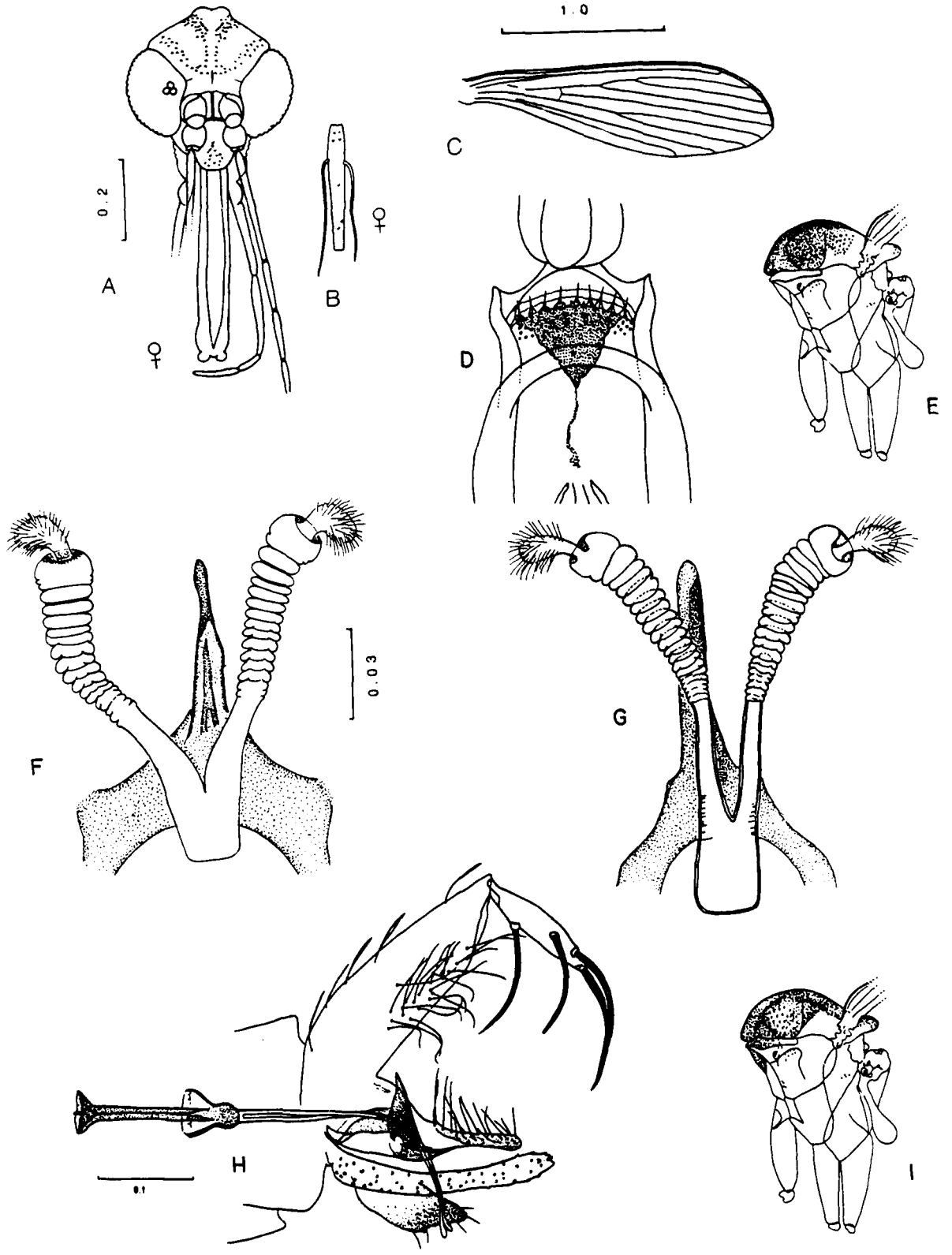



Plate 21-17

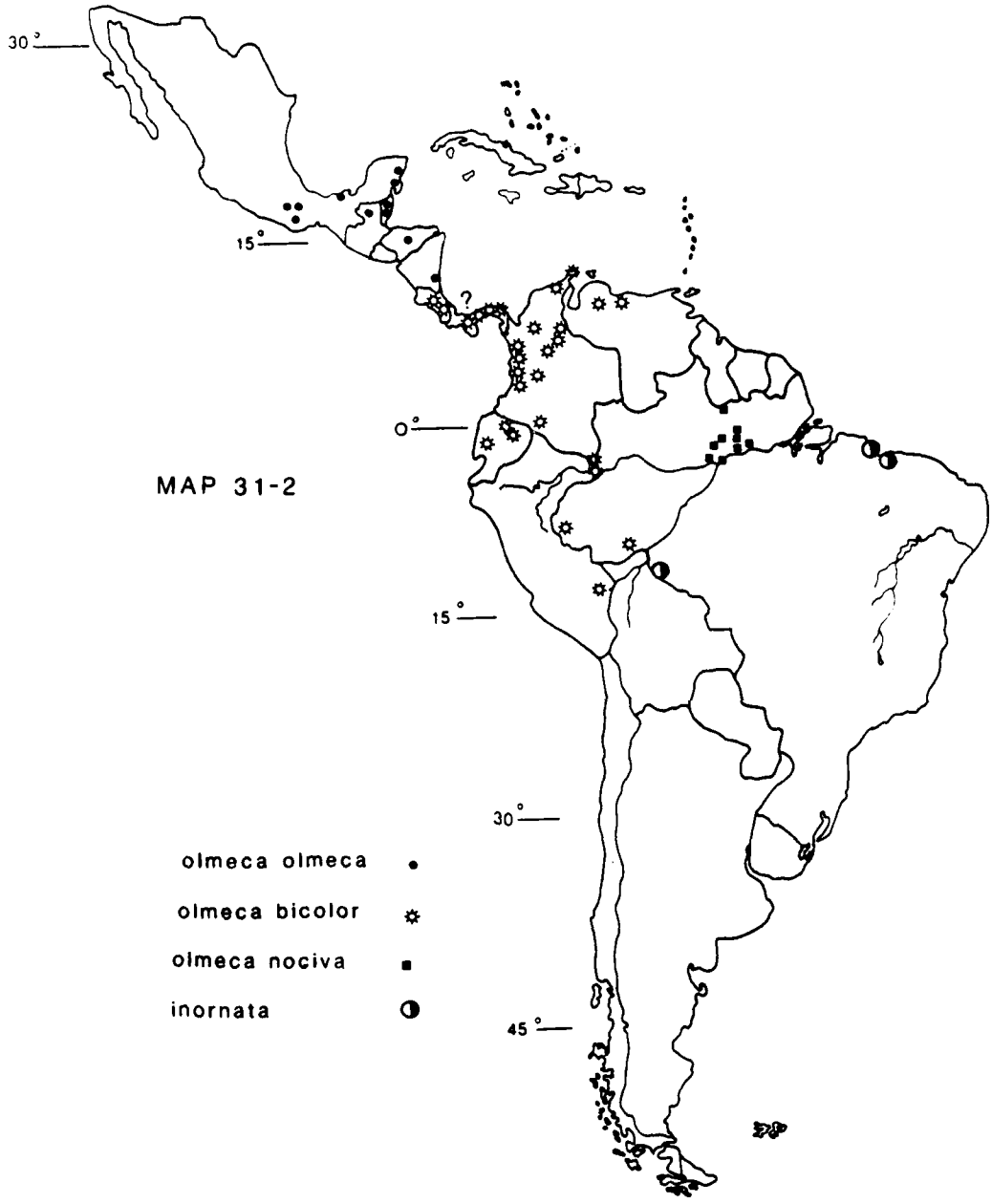
Lutzomyia richardwardi. A. Female head; B. Female flagellomere II; C. Female wing; D. Female cibarium; E. Thorax; F. Spermathecae.

Lutzomyia shawi. G. Spermathecae; H. Male terminalia; I. Thorax (fig. H from Fraiha et al. 1981).

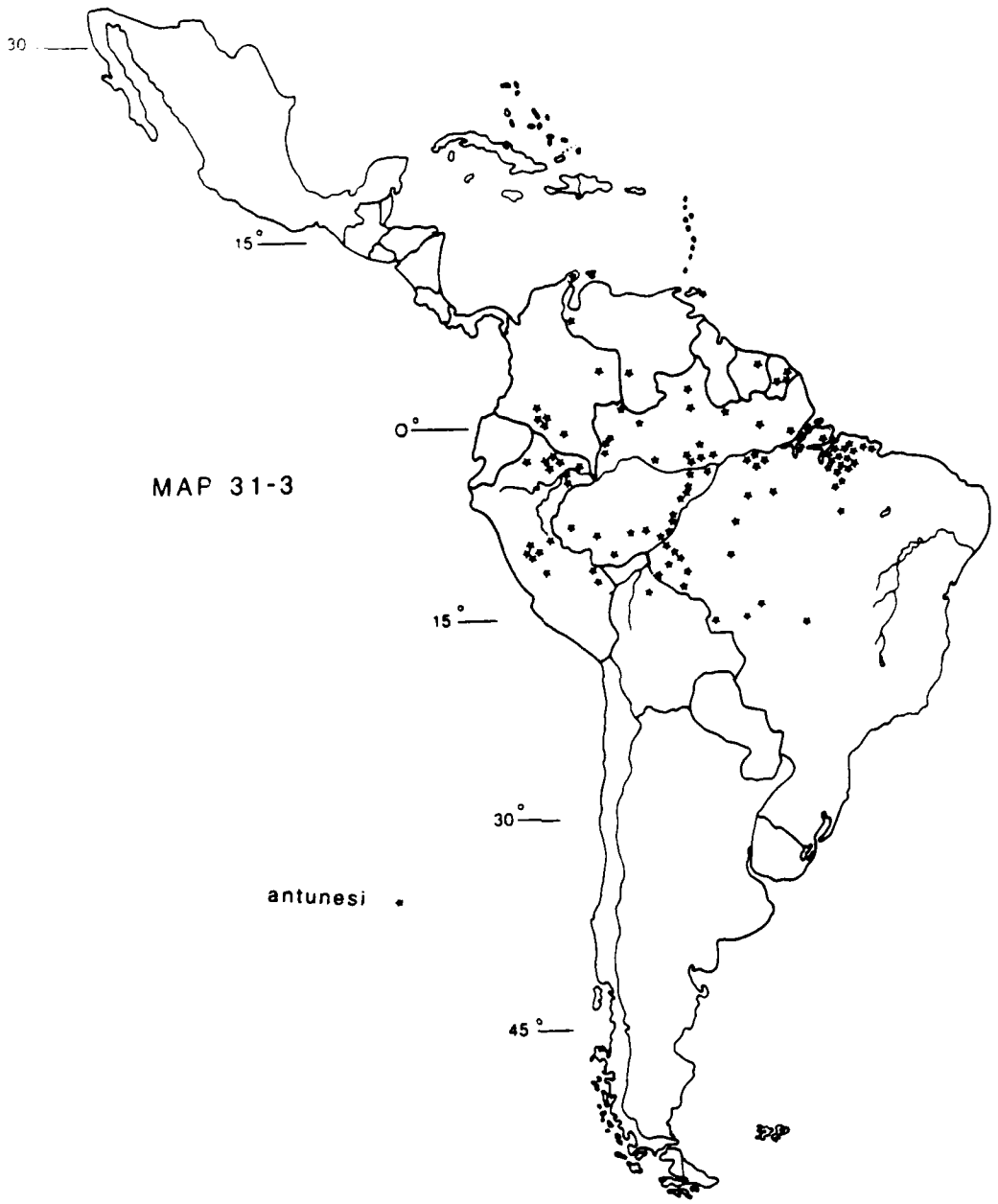



MAP 31-1

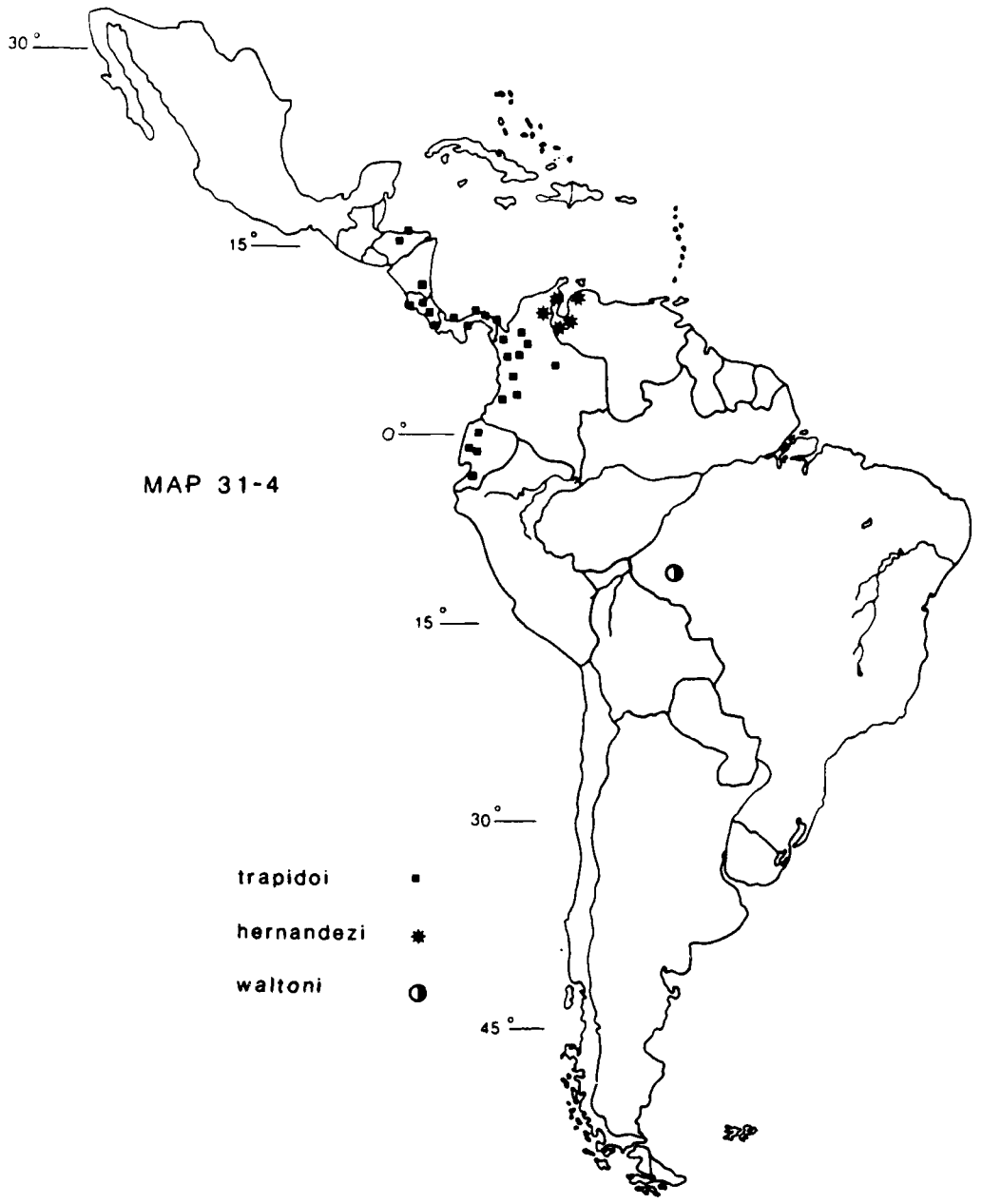
flaviscutellata ■


30°
15°
0°
15°
30°
45°
olmeca olmeca
olmeca bicolor
olmeca nociva
inornata

MAP 31-2




MAP 31-3

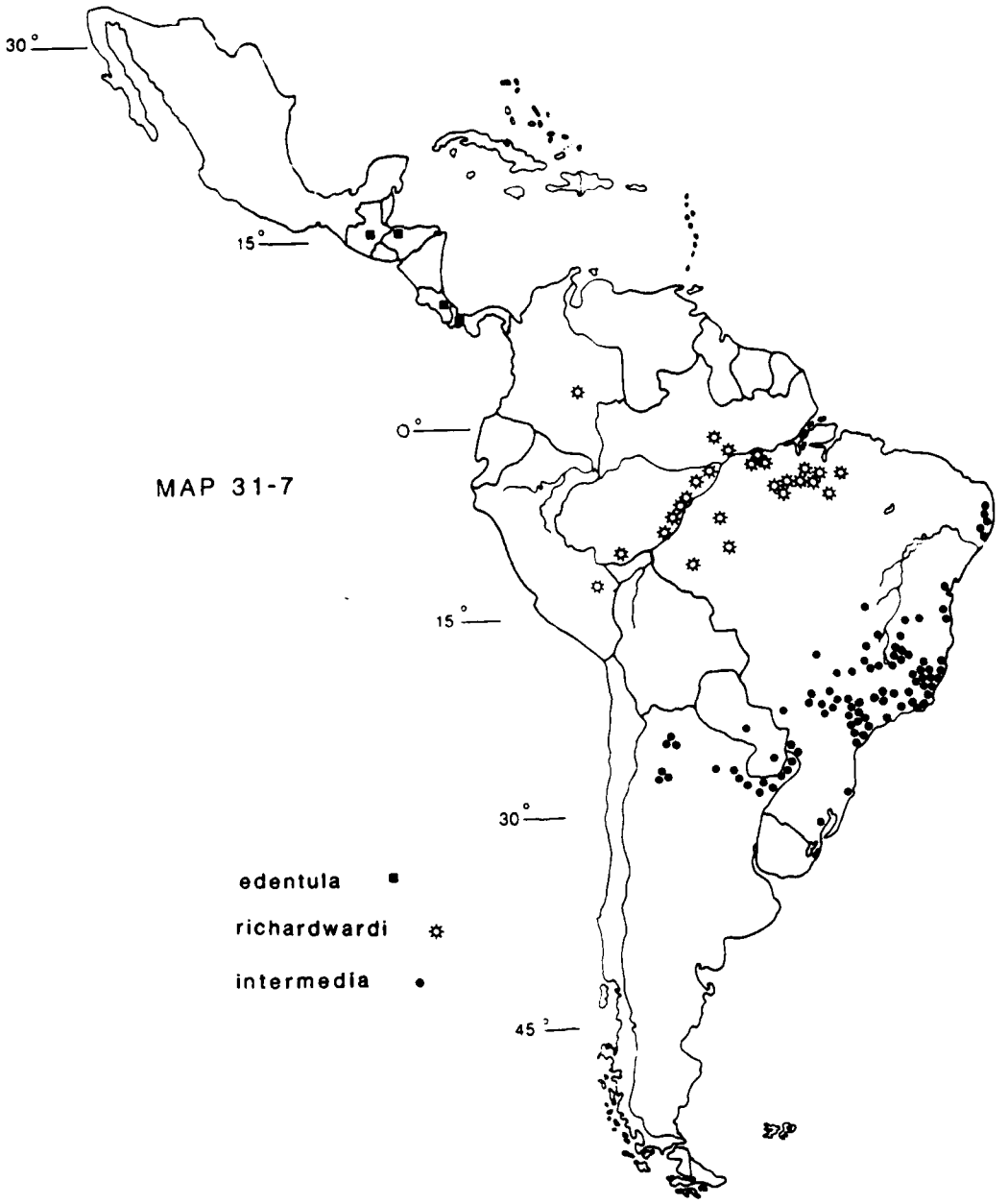



MAP 31-4




MAP 31-5


30°
15°
0°
15°
30°
45°
MAP 31-6
sylvicola
ylephiletor




MAP 31-7




MAP 31-8.




MAP 31-9




MAP 31-10




MAP 31-11

## 52. Lutzomyia Subgenus Trichophoromyia Barretto

Lutzomyia subgenus Trichophoromyia Barretto 1962: 96 (type species: Flebotomus ubiquitalis Mangabeira by orig. designation). Sherlock & Guitton 1970: 137 (reviewed, keys, figs.). Martins et al. 1978: 81 (defined).

Lutzomyia species group auraensis: Theodor 1965: 185.

Lutzomyia species group castanheirai: Theodor 1965: 193.

Psychodopygus subgenus Trichophoromyia (in part): Forattini 1971a: 105; 1973: 425 (defined).

Identification. Coloration dusky to dark; no completely pale species known. Antennal ascoids long, with short, barely discernible, posterior spurs. Palpomere 5 relatively short, less than combined length of palps. 3 + 4. ♀ cibarium with 6 or more horizontal teeth & numerous vertical teeth; pigment patch dark & arch incomplete. ♀ pharynx unarmed. Spermathecae annulated, terminal annulation of most spp. much larger than others; ducts thin-walled, variable in length; smooth walled or not. ♀ cercus broad & short. ♂ genitalia. Coxite with 1 or more groups of persistent setae. Style with 4 spines inserted at different levels; subterminal seta absent. Aedeagus well pigmented, its width & length usually subequal. Paramere variable. Lateral lobe with largest dorsal setae near, and at, apex.

Except for L. reburra which occurs west and north of the Andes mountains, the remaining Lutzomyia (Trichophoromyia) spp. inhabit Amazonian forests where many of the species appear to have limited geographic ranges.

The 4 species in the dreisbachi species group share many character states with the Trichophoromyia species but their antennal ascoids have long posterior spurs. Also, some of the Lutzomyia (Nyssomyia) species, especially females, resemble those of Trichophoromyia but they can be distinguished by minor features discussed on p. 539.

In general, the Trichophoromyia females are remarkably similar in structure and it is impossible to create a meaningful key to this sex. Many species are known only from the male.

Medical Importance. Unknown; females are not anthropophilic. Some observations (Ryan 1986; F. Le Pont, pers. comm.) suggest that birds may serve as hosts for some species. However, unidentified Leishmania flagellates were recently detected using monoclonal antibodies in wild-caught L. ubiquitalis in Brazil (Ryan et al. 1987a).

Key to the Males of the Subgenus Trichophoromyia spp.

1. Paramere with 1 apical & 3-4 ventral peg-like setae with rounded tips & a distinct dorsal group of 15 long setae, downwardly bent & with rounded tips. ... Lutzomyia (Trichophoromyia) n.sp. #3 (Pl. 32-1)

Paramere without such peg-like setae or group of long modified setae. ..... 2

2. Genital filaments shorter than 4X length of genital pump. ..... 3

Genital filaments longer than 4X length of genital pump. ..... 6

3. Paramere with most of dorsal setae sinuous. Genital filament tips slender, acute. ..... L. reburra (Pl. 32-2)

Paramere with nonsinuous dorsal setae. Genital filament tips slightly expanded, rounded. ..... 4

4. Lateral lobe longer (ca. 0.50 mm) extending to level of proximal spine on style. Coxite with group of persistent setae inserted mainly at basal third of structure. ..... L. meirai (Pl. 32-3)

Lateral lobe shorter than 0.45 mm, ending before level of proximal spine on style. Cosite with basal median group of persistent setae. ..... 5

5. Paramere as shown, distal third upturned. ..... L. omagua (Pl. 32-4)

Paramere otherwise more slender, distal third not upturned. ..... L. ubiquitalis (Pl. 32-5)

6. Coxite with one or more spine-like setae, subequal in width to proximal spine on style. ..... 7

Coxite without such large setae. ..... 12

7. Paramere with slender dorsal tubercle, bearing 2 recurved setae, between proximal dorsal lobe & end of paramere. ..... ..... Lutzomyia (Trichophoromyia) n.sp. #4 (Pl. 32-6)
Paramere without such a tubercle, isolated setae between proximal dorsal lobe & end of paramere present or not. ..... 8

8. Paramere with upturned, truncated end; dorsal lobe relatively large. Coxite with 3 large spine-like setae & no other basal or median persistent setae. ..... L. dunhami (Pl. 32-7)
Paramere otherwise; dorsal lobe smaller. Coxite with spine-like setae in a group with other, smaller persistent setae. ..... 9

9. Paramere with dorsal group of 2 to 5 long setae isolated from others & between proximal lobe & end of paramere. ..... 10
Paramere without such a group of isolated setae. ..... 11

10. Coxite with persistent setae including 2 spine-like setae, larger than others. Lateral lobe shorter than 0.50 mm. Paramere relatively slender at apex as shown. ..... L. viannamartinsi (Pl. 32-8)
Coxite with 4-7 spine-like setae included in group of numerous thinner setae. Lateral lobe longer than 0.50 mm. Paramere broader at apex as shown. ..... .. L. brachipyga (Pl. 32-9)

11. Paramere, beyond proximal lobe upturned; its length about 4X height of proximal lobe. Coxite with 6-10 very thick setae. ..... Lutzomyia (Trichophoromyia) n.sp. #5 (Pl. 32-10)

Paramere, beyond proximal lobe, curved downwards or straight; its length subequal to height of dorsal lobe. Coxite with 3-4 very thick setae. ..... L. readyi (Pl. 32-11)

12. Coxite with subterminal group of 4-6 long, straight sets; other persistent setae lacking. ..... L. saltuosa (Pl. 32-12)
Coxite with basal and/or median groups of persistent setae. ..... 13

13. Paramere with distinct tubercle bearing apical setae at base of proximal lobe. ..... 14
Paramere with or without proximal lobe; if present, with tubercle at base. ..... 16

14. Paramere as shown, with proximal lobe bearing long apical setae, some of which are longer than 2X maximum width of style. Coxite with fewer than 16 persistent setae loosely grouped at & near middle of structure. ..... L. castanheirai (Pl. 32-13)
Paramere otherwise, with proximal lobe bearing apical setae shorter than maximum width of style. Coxite with compact tuft of 19 or more setae. ..... 15

15. Paramere with subterminal dorsal projection, similar in size & shape to end of paramere & ventral projection. Coxite with compact tuft of setae at base & separate median group. ... L. lopesi (Pl. 32-14)
Paramere otherwise, without ventral projection. Coxite with single compact group or persistent setae. ..... L. eurypyga (Pl. 32-15)

16. Paramere, at greatest width, & including dorsal lobe (if present), at least 2X width of lateral lobe at middle of structure. Genital filament tips not inflated. ..... 17

Paramere, at greatest width, less than 2X width of lateral lobe at middle of structure. Genital filament tips inflated or not. ..... 18

17. Paramere with group of 10+ curved setae at apex of dorsal lobe; most other setae subequal in size. ..... L. melloi (Pl. 32-16)

Paramere without such a group of setae on dorsal lobe but with longitudinal row of 6-10 short, broad setae distinctly wider than others. ..... L. innini (Pl. 32-16)

18. Paramere with small lobe or appendage arising from lateral ventral margin. ..... 19

Paramere lacking such a lobe. ..... 20

19. Paramere with dorsal setae restricted to distal third or structure, most shorter than maximum width of paramere. Genital filament tips inflated, spear-shaped. ..... L. acostai (Pl. 32-17)

Paramere broader, with dorsal setae on distal half of structure, at least 10 of which are longer than maximum width of paramere. Genital filaments not inflated or spear-shaped.... L. flochi (Pl. 32-18)

20. Coxite with 2-3 distinct groups of persistent setae (excluding subapical setae)..... 21

Coxite with 1 distinct group of persistent setae (excluding subapical setae). ..... 23

21. Paramere concave on dorsal margin from dorsal lobe to end of paramere. ..... 22

Paramere not concave on dorsal margin. ..... 23

22. Coxite with ventral group or persistent setae, in addition to median median group; inner base without group of slender setae. Paramere as shown. ..... L. napoensis (Pl. 32-19)

Coxite without ventral group of persistent setae; with basal group of 2-5 small, slender setae & median group. Paramere otherwise. ..... Lutzomyia (Trichophoromyia) n.sp. #6 (Pl. 32-20)

23. Paramere subtriangular, narrowing to apex. Coxite with 4-5 ventral group of setae between smaller basal group and median group. ..... L. cellulana (Pl. 32-21)

Paramere otherwise. Coxite without ventral group of resistant setae. ..... L. octavioi (Pl. 32-22)

24. Paramere almost truncate, broad apically with subapical dorsal group of 5 strong, straight setae. ..... L. wilkersoni (Pl. 32-23)

Paramere otherwise, without such setae. ..... 24

25. Coxite with median group of 10 or fewer setae. ..... 26

Coxite with median group of 12 or more setae. ..... 27

26. Paramere with conspicuous dorsal lobe. .....

..... Lutzomyia (Trichophoromyia) n.sp. #2 (Pl. 32-24)

Paramere without dorsal lobe. .....

..... Lutzomyia (Trichophoromyia) n.sp. #1 (Pl. 32-25)

27. Coxite with median group of 25 or fewer setae. ..... 28

Coxite with group of 30 or more persistent setae. ..... 30

28. Paramere with prominent high dorsal hump beyond which paramere is slender & slightly clubbed apically. ..... L. beniensis (Pl. 32-26)

Paramere with or without dorsal hump (if present it is shorter & broader). Paramere beyond hump relatively broad. ..... 29

29. Coxite with persistent setae having recurved tips. Paramere with distal third wider than width of lateral lobe... L. incasica (Pl. 32-27)

Coxite with persistent setae not recurved at their tips. Paramere otherwise, more slender than width of lateral lobe. .....

..... L. rostrans (Pl. 32-28)

30. Paramere with conspicuous dorsal lobe or hump. ..... 31

Paramere without dorsal lobe or hump. ..... 33

31. Coxite tuft of 35 or more setae, all inserted very close together at middle of segment. Paramere with mostly straight dorsal setae... 32

Coxite tuft less compact but with fewer setae. Paramere with many setae having recurved tips. ..... L. loretonensis (Pl. 32-29)

32. Paramere with 4-6 long setae near lateral ventral margin of apex. ..... Lutzomyia sp. 1 of Araracuara (Pl. 32-30)

Paramere lacking such setae. ..... L. howardi (Pl. 32-12 & 32-30)

33. Genital filament tips simple, not expanded & spear-shaped. Paramere as shown. ..... L. ruii (Pl. 32-31)

Genital filament tips expanded, spear-shaped. Paramere otherwise. ..... L. auraensis (Pl. 32-5)

## Lutzomyia (Trichophoromyia) n.sp. #3

Plate 32-1

Distribution (Map 32-1). Brazil (1 ♂, Pará, 164 km W of Altamira, flight trap in forest, 12 Nov. 1974, J. Reinert).

Remarks. This distinctive species, known only from a single teneral male, differs from other males in this subgenus by the presence of modified setae in a compact group at the dorsum of the paramere. There are also unusual peg-like setae at the paramere apex & along the ventral margin.

## Lutzomyia (Trichophoromyia) reburra (Fairchild & Hertig)

Plate 32-2

Phlebotomus reburrus Fairchild & Hertig 1961b: 246 (♂, La Zumbadora, Cerro Azul, Panama; ♀, Rio Mandinga, Panama).

Lutzomyia reburra: Barretto 1962: 97 (listed). Martins et al. 1978: 87 (refs., dist.). Young 1979: 146 (full refs.). Young & Rogers 1984: 599 (Ecuador). Murillo & Zeledón 1985: 48 (♂, ♀, Costa Rica).

Psychodopygus reburrus: Forattini 1971a: 105 (listed); 1973: 477 (♂, ♀ figs.).

Distribution (Map 32-2). Costa Rica (Murillo & Zeledón 1985); Panama (Fairchild & Hertig 1961b); Colombia (Young 1979); Ecuador (Young & Rogers 1984).

Remarks. The female of this species is distinguished from other Lutzomyia (Trichophoromyia) females by the presence of spherical excressences on most of the individual sperm ducts. The female of L. yuilli pajoti in the subgenus Nyssomyia has similar structures but this species is nearly pale and has much shorter sperm ducts.

## Lutzomyia (Trichophoromyia) meirai (Causey & Damasceno)

Plate 32-3

Flebotomus meirai Causey & Damasceno 1945: 654 (♂, São Paulo de Olivenca, Amazonas, Brazil)

Lutzomyia meirai: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Sherlock & Guitton 1970: 146 (keyed, fig.). Martins et al. 1978: 86 (refs., dist.).

Psychodopygus meirai: Forattini 1971a: 105 (listed); 1973: 472 (♂ fig., dist.).

Distribution (Map 32-3). Brazil (Martins et al. 1978).

Remarks. We examined & partially illustrated (Pl. 32-3) the holotype male housed in the USNM in 1986. The parameres are slightly compressed and the ventral heel is not as pronounced as shown by Causey & Damasceno (1945). In many aspects, this little-known species resembles L. omagua and further studies based on adequate samples may indicate these forms are distinct only as subspecies. The female of L. meirai remains unknown.

## Lutzomyia (Trichophoromyia) omagua Martins, Llanos & Silva

Plate 32-4

Lutzomyia omagua Martins, Llanos & Silva 1976b: 496 (♂, Pucallpa, Loreto, Peru). Martins et al. 1978: 155 (listed). Llanos 1981: 183 (listed). Young et al. 1985: 143 (Madre de Dios, Peru).

Distribution (Map 32-4). Peru (refs. cited above).

Remarks. Martins et al. (1976b; 1978) provisionally placed L. omagua in species group dreisbachi but the male lacks long posterior spurs of the antennal ascoids as well as persistent setae near the apex of the coxite. The female, partially illustrated here, from Tambopata Reserve, Madre de Dios, Peru, will be fully described in a forthcoming article.

Lutzomyia (Trichophoromyia) ubiquitalis (Mangabeira)

Plate 32-5

Flebotomus ubiquitalis Mangabeira 1942a: 158 (♂, Aurá, Belém, Pará, Brazil).

Phlebotomus basispinosus Barretto & Coutinho 1943b: 185 (♂, San Jose dos Campos, São Paulo, Brazil). Barretto 1954: 124 (as synonym of ubiquitalis).

Phlebotomus cauchensis Floch & Abonnenc 1943a: 22 (♂, French Guiana). Barretto 1954: 124 (as synonym of ubiquitalis).

Lutzomyia ubiquitalis: Barretto 1962: 97 (listed). Martins et al. 1978: 82, 87 (♂, ♀ figs., dist.). Leger et al. 1977: 218 (French Guiana). Young 1979: 149 (♂ figs., refs.). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 96 (Colombia). Arias & Young 1982: 251 (♀ fig.). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Young et al. 1985: 143 (Peru). Geoffroy et al. 1986: 486 (French Guiana). Ryan et al. 1987a: 356 (natural infections, unidentified Leishmania Brazil). Lebbe et al. 1987: 30 (computer aided ident.).

Psychodopygus ubiquitalis: Forattini 1971a: 105 (listed); 1973: 481 (figs., dist.).

Distribution (Map 32-2). Colombia; Brazil; Venezuela; French Guiana (Martins et al. 1978 & subsequent refs. given above); Peru (Young et al. 1985); Suriname (♂♂, Patamakka & Gran Santi, 1983-1984, A.M. Burgos).

Remarks. The recent discovery of Leishmania in wild caught females of L. umbratilis in Brazil (Ryan et al. 1987a) represents the first time that any members in this subgenus have been found naturally infected with these protozoans.

## Lutzomyia (Trichophoromyia) n.sp. #4

Plate 32-6

Distribution (Map 32-5). Brazil (3 ♂♂, Amazonas, km 102 Hwy. (Br.) 319, Manaus - Porto Velho, light traps, June 1979, J. Arias).

Remarks. The male of this undescribed species readily differs from those of L. brachypyga, L. viannamartinsi and L. (Trichophoromyia) n.sp. #5 by the slender setiferous tubercle between the proximal lobe and end of the paramere. Such a process is lacking in these other species.

## Lutzomyia (Trichophoromyia) dunhami (Causey & Damasceno)

Plate 32-7

Flebotomus dunhami Causey & Damasceno 1945: 17 (♂, Coimbra, Benjamin Constant, Amazonas, Brazil, Fig. 22 not 20).

Lutzomyia dunhami: Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 144 (♂ fig., keyed). Martins et al. 1978: 84 (refs., dist.).

Psychodopygus dunhami Forattini 1971a: 105 (listed); 1973: 463 (♂ fig., tax.).

Distribution (Map 32-1). Brazil (Martins et al. 1978).

Remarks. Lutzomyia dunhami is a poorly known sand fly. The holotype (Pl. 32-7) is housed in the USNM collection and was studied by us in 1986.

Lutzomyia (Trichophoromyia) viannamartinsi Sherlock & Guitton

Plate 32-8

Lutzomyia viannamartinsi Sherlock & Guitton 1970: 137 (♂, Municipio de Urucuca, Bahia Brazil); 1976: 7 (as valid species, distinct from brachipyga). Martins et al. 1978: 88 (listed, dist.).

Phlebotomus brachipygus (not brachypygus Mangabeira): Sherlock & Carnheiro 1962: 42 (♀ descript.).

Lutzomyia brachipyga: Vexenat et al. 1986b: 296 (Bahia, Brazil).

Psychodopygus viannamartinsi: Forattini 1973: 459 (as synonym of brachipyga).

Distribution (Map 32-2). Brazil (type locality; 42 ♂♂, 18 ♀♀, Tres Bracos, Bahia, light traps, 1986, A.L. Hoch).

Remarks. Forattini (1973) treats L. viannamartinsi and L. brachipyga as conspecific but we support the conclusions of Sherlock & Guitton (1976) who pointed out consistent structural differences between the males.

That of the former species has but 2 large spine-like setae, not 5 as in brachipyga, inserted among thinner setae on the coxite. Other metrical differences are apparent between these males but the females are not distinguishable with certainty.

Lutzomyia (Trichophoromyia) brachipyga (Mangabeira)

Plate 32-9

Flebotomus brachipygus Mangabeira 1942a: 173 ( ♂, Aurá, Belém, Pará, Brazil).

Phlebotomus brachipygus: Fauran 1960: 2 (♂, French Guiana).

Lutzomyia brachipyga (or brachypyga): Barretto 1962: 97 (listed). Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 144 (♂ fig., keyed). Lewis 1975a: 502 (mouthpart morphol.). Sherlock & Guitton 1976: 7 (cf. to viannamartinsi). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 84 (refs., dist.). Ready et al. 1983: 780 (Pará, Brazil). Ryan 1986: 98 (♀ descript., ♂ fig., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil). Lebbe et al 1987: 30 (computer aided tax.).

Psychodopygus brachipygus: Forattini 1971a: 105; 1973: 459 (in part, ♂, ♀).

Distribution (Map 32-6). Brazil (Martins et al. 1978; Ryan 1986); French Guiana (Floch & Abonnenc 1952; Leger et al. 1977).

Remarks. Records of L. brachipyga in Bahia State, Brazil, at Tres Bracos (Vexenat et al. 1986) are misidentifications of L. viannamartinsi.

Fauran (1960) noted that a male brachipyga from Grand-Santi, French Guiana differed from that described by Mangabeira (1942a) in details of the coxite setation and paramere structure. The French Guiana male, with a slender tubercle on the dorsum of the paramere, resembles L. (Trichophoromyia) n.sp. #4 more than L. brachipyga from Pará, Brazil and suggests that the forms may not be conspecific. However, none of 10 ♂♂ from French Guiana (Prapock & Cayenne) that we studied, through the courtesy of J.-P. Dedet, had such tubercles on their parameres.

## Lutzomyia (Trichophoromyia) n.sp. #5

Plate 32-10

Distribution (Map 32-7). Venezuela (2 ♂♂, 1 ♀, Cerro Neblina, Amazonas, flight trap, 2 Jan 1985, D. Feliciangeli & A. Ramirez).

Remarks. This species is being described and named by D. Feliciangeli. Its closest relatives are L. brachipyga, L. viannamartinsi and L. (Trichophoromyia) n.sp. #4 from which the male differs in the shape and setation of the parameres and size and number of spine-like setae on the coxite.

Lutzomyia (Trichophoromyia) readyi Ryan

Plate 32-11

Lutzomyia readyi Ryan 1986: 103 (♂, ♀, Transamazon Highway, Itaituba-Altamira, km 25, Pará, Brazil).

Distribution (Map 32-5). Brazil (type locality).

Remarks. We examined a topotype male of L. readyi and noted that the dorsal lobe of the paramere was bent downwards due to the pressure of the coverslip (Pl. 32-11 and Ryan 1986). The normal position is depicted on Plate 32-11.

Lutzomyia (Trichophoromyia) saltuosa Young

Plate 32-12

Lutzomyia saltuosa Young 1979: 148 (♂, Leticia, Amazonas, Colombia).

Distribution (Map 32-4). Colombia (type locality).

Remarks. At present, the male of L. saltuosa is the sole member of the subgenus that lacks a median group of setae on the coxite.

Lutzomyia (Trichophoromyia) castanheirai (Damasceno, Causey & Arouck)

Plate 32-13

Flebotomus castanheirai Damasceno, Causey & Arouck 1945: 15 (♂, Itaúna, Amazonas, Brazil).

Lutzomyia castanheirai: Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 140 (♂ fig., keyed). Martins et al. 1978: 84 (refs., dist.). Ryan 1986: 100 (♂, ♀, Pará, Brazil).

Psychodopygus castanheirai: Forattini 1971a: 105; 1973: 462 (figs., tax.).

Distribution (Map 32-8). Brazil (Martins et al. 1978; Ryan 1986).

Lutzomyia (Trichophoromyia) lopesi (Damasceno, Causey & Arouck)

Plate 32-14

Flebotomus lopesi Damasceno, Causey & Arouck 1945: 13 (♂, Tefé, Rio Solimoes, Amazonas, Brazil).

Lutzomyia lopesi: Barretto 1962: 97 (listed). Theodor 1965: 194. Sherlock & Guitton 1970: 145 (♂ fig., keyed). Martins et al. 1978: 85 (refs., dist.).

Psychodopygus lopesi: Forattini 1971a: 105 (listed); 1973: (♂ fig., tax.).

Distribution (Map 32-3). Brazil (type locality).

Remarks. The male of L. lopesi is easily recognized by the distinctive shape of the parameres, shown on Plate 32-14 and drawn from the male holotype in the USNM. The female is undescribed.

Lutzomyia (Trichophoromyia) eurypyga Martins, Falcao & Silva

Plate 32-15

Lutzomyia eurypyga Martins, Falcao & Silva 1963: 336 (♂, ♀, Pissarreira, Caracaraí, Roraima, Brazil). Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 145 (♂ fig., keyed). Martins et al. 1978: 85 (refs., dist.). Ryan 1986: 102 (♂, ♀ figs., Pará, Brazil).

Psychodopygus eurypygus: Forattini 1971a: 105 (listed); 1973: 465 (♂ fig., tax.).

Distribution (Map 32-1). Brazil (Martins et al. 1978; Ryan 1986).

Remarks. The male of L. eurypyga resembles L. brachipyga, L. viannamartinsi and L. (Trichophoromyia) n.sp. #4 in having enormous terminalia but the coxite tuft consists of numerous, subequal setae.

Lutzomyia (Trichophoromyia) melloi (Causey & Damasceno)

Plate 32-16

Flebotomus melloi Causey & Damasceno 1945: 20 (♂, Coari, Amazonas, Brazil).

Lutzomyia melloi: Barretto 1962: 97. Theodor 1965: 194 (listed). Sherlock & Guitton 1970: 146 (♂ fig., keyed). Martins et al. 1978: 86 (refs., dist.).

Psychodopygus melloi: Forattini 1971a: 105 (listed); 1973: 474 (♂ fig., tax.).

Distribution (Map 32-9). Brazil (type locality; 5 ♂♂, Labrea, Amazonas, light trap, 10 Oct. 1972, D. Young).

Remarks. The record of L. melloi in Suriname (Hudson & Young 1985) should be changed to L. ininni, a closely related species considered erroneously to be a junior synonym of L. melloi by Arias & Young (1982). The shape and setation of the parameres differ between the males of these species.

Lutzomyia (Trichophoromyia) ininii (Floch & Abonnenc)

Plate 32-16

Phlebotomus ininii Floch & Abonnenc 1943a: 20 (♂, Caux, French Guiana); 1944d: 6 (♀); 1952: 88 (♂, ♀).

Lutzomyia ininii: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Sherlock & Guitton 1970: 145 (♂ fig., keyed). Leger et al. 1977: 221 (French Guiana). Martins et al. 1978: 85 (refs., dist.). Geoffroy et al. 1986: 486 (French Guiana). Lebbe et al. 1987: 30 (computer aided ident.).

Lutzomyia melloi (not melloi Causey & Damasceno): Hudson & Young 1985: 418 (Suriname).

Psychodopygus ininii: Forattini 1971a: 105 (listed); 1973: 471 (♂ fig., tax.).

Distribution (Map 32-9). Suriname (Hudson & Young 1985); French Guiana (Floch & Abonnenc 1952; Leger et al. 1977; Geoffroy et al. 1986).

Lutzomyia (Trichophoromyia) acostai (Llanos)

Plate 32-17

Phlebotomus townsendi (not P. townsendi Ortiz). Llanos 1964: 377 (Serafin, Loreto, Peru).

Phlebotomus acostai Llanos 1966: 369 (new name).

Lutzomyia acostai: Sherlock & Guitton 1970: 144 (♂ fig., keyed). Martins et al. 1978: 82 (refs, dist.). Llanos 1981: 183 (listed).

Psychodopygus acostai: Forattini 1971a: 105 (listed); 1973: 454 (♂ fig., tax.)

Distribution (Map 32-2). Peru (Llanos 1964; 1983).

Remarks. One of us (D.Y.) was unable to locate the holotype, or other specimens, of L. acostai in the collection at the National Institute of

Health, Lima, Peru, in 1988. We have not examined specimens referable to this species.

Lutzomyia (Trichophoromyia) flochi (Abonnenc & Chassignet)

Plate 32-18

Phlebotomus flochi Abonnenc & Chassignet 1948: 1 (♂, Baduel, French Guiana). Floch & Abonnenc 1952: 117 (♂ figs.).

Lutzomyia flochi: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Sherlock & Guitton 1970: 145 (♂ fig., keyed). Legér et al. 1977: 220 (French Guiana). Martins et al. 1978: 85 (refs., dist.). Biancardi et al. 1982: 175 (Rondonia, Brazil). Arias & Freitas 1982: 405 (Acre, Brazil). Lebbe et al. 1987: 30 (computer aided ident.).

Psychodopygus flochi: Forattini 1971a: 105 (listed); 1973: 465 (♂ fig., tax.).

Distribution (Map 32-10). French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982)

Lutzomyia (Trichophoromyia) napoensis Young & Rogers

Plate 32-19

Lutzomyia napoensis Young & Rogers 1984: 600 (♂, ♀, Limoncocha, Napo, Ecuador)

Distribution (Map 32-8). Ecuador (type locality).

## Lutzomyia (Trichophoromyia) n.sp. #6

Plate 32-20

Phlebotomus octavioi (not octavioi Vargas): Buck et al. 1967 (♂♂, Cochicoto, Huánuco, Peru, & San Antonio, Loreto, Peru).

Lutzomyia octavioi (not octavioi Vargas): Llanos et al. 1975a: 659 (♂, ♀ figs., Quellouno, Cuzco, Peru). Young & Rogers 1984: 603 (♂ structurally distinct from octavioi).

Distribution (Map 32-11). Peru (above refs.).

Remarks. This species, mistakenly identified and illustrated as L. octavioi (Vargas) by Llanos et al. (1975b), differs in the male by the shape of the parameres and by the presence of 14 to 17 strong setae on the coxite. The male of L. octavioi has only 9 such setae & its paramere lacks a dorsal lobe. Sherlock & Guitton (1970) noted that Mangabeira's original illustrations of octavioi (1942a, as P. affinis) agreed perfectly with type material studied by them. We examined specimens of L. (Trichophoromyia) n.sp. #6 (7 ♂♂) from Cachicoto, Peru, and determined that they represented "L. octavioi" of Llanos et al. (1975b). Our material of L. octavioi from Costa Marquez, Rondonia, Brazil, is identical to L. octavioi Vargas, described by Mangabeira (1942a, as P. affinis).

## Lutzomyia (Trichophoromyia) cellulana Young

Plate 32-21

Lutzomyia cellulana Young 1979: 142 (♂ . ? ♀, Tres Esquinas, Caqueta, Colombia).

Distribution (Map 32-4). Colombia (type locality); Ecuador (1 ♂, 25 km NE of Puerto Misahuali at Santa Rosa, Napo, light trap, 26 July 1982, D. Duckhouse.

Remarks. The male of L. cellulana from Ecuador has a slightly broader paramere than Colombian specimens (Pl. 32-21) but we consider them conspecific.

## Lutzomyia (Trichophoromyia) octavioi (Vargas)

Plate 32-22

Flebotomus affinis (not P. affinis Theodor) Mangabeira 1942a: 166 (♂, Mamoré near Brazil-Bolivia border, Mato Grosso, Brazil).

Phlebotomus octavioi Vargas 1949: 267 (new name for affinis Mangabeira 1942a).

Lutzomyia octavioi: Barretto 1962: 97 (listed). Theodor 1965: 185 (listed). Lewis 1967b: 134 (refs.). Sherlock & Guitton 1970: 146 (♂ fig., keyed). Martins et al. 1978: 86 [in part, Peru records = Lutzomyia

(Trichophoromyia) sp. #6]. Biancardi et al. 1982· 168 (Rondonia, Brazil).

Psychodopygus octavioi· Forattini 1971a: 105; 1973: 478 (in part, as synonym of rostrans Summers).

Distribution (Map 32-11). Brazil (Mangabeira 1942a; Biancardi et al. 1982; 5 ♂♂, Costa Marquez, Rondonia, flight trap, April 1987, T. Klein).

Remarks. Forattini (1973) regards L. octavioi as a junior synonym of L. rostrans Summers but the male of the latter species, as described and figured by Lewis (1975b) lacks the group of 3-4 small setae at the coxite base and the median group of setae on the same structure are longer and more numerous. The paramere appears to be more slender than that of L. octavioi. In view of these observations, we disagree with the proposed synonym.

## Lutzomyia (Trichophoromyia) wilkersoni Young & Rogers

Plate 32-23

Lutzomyia wilkersoni Young & Rogers 1984: 603 (♂, ♀, near Zamora, Zamorchinchipe, Ecuador).

Distribution (Map 32-4). Ecuador (type locality).

## Lutzomyia (Trichophoromyia) n.sp. #2

Plate 32-24

Lutzomyia sp. #2 Young et al. 1985.

Distribution (Map 32-10). Peru (Young et al. 1985).

Remarks. The male of this species and that of L. (Trichophoromyia) n.sp. #1 were taken together at the Tambopata Reserve, Madre de Dios, Peru. The parameres of each differ in shape but their coxites have fewer than 10 persistent setae forming an inner median group.

## Lutzomyia (Trichophoromyia) n.sp. #1

Plate 32-25

Lutzomyia sp. #1 Young et al. 1985: 143 (♂♂, Tambopata Reserve, Made de Dios, Peru).

Distribution (Map 32-5). Peru (Young et al. 1985).

Remarks. We are not able to associate females of this species and L. (Trichophoromyia) n.sp. #2 that were collected together in Peru (Young et al. 1985).

## Lutzomyia (Trichophoromyia) beniensis Le Pont & Desjeux

Plate 32-26

Lutzomyia beniensis Le Pont & Desjeux 1987a: 189 (♂, ♀, Rio Beni, Beni, Bolivia).

Distribution (Map 32-11). Bolivia (type locality).

Remarks. The shape of the parameres readily serves to distinguish this species from others in the subgenus. Females may feed on birds (Le Pont & Desjeux 1987a).

## Lutzomyia (Trichophoromyia) incasica (Llanos)

Plate 32-27

Phlebotomus adleri (not P. adleri Theodor) Llanos 1964: 379 (♂, Cahuide, Loreto, Peru).

Phlebotomus incasicus Llanos 1966: 369 (new name).

Lutzomyia incasica: Sherlock & Guitton 1970: 145 (♂ fig., keyed). Martins et al. 1978: 85 (refs., dist.). Llanos 1981: 183 (listed).

Psychodopygus incasicus: Forattini 1971a: 105 (listed); 1973: 468 (♂ fig., tax.).

Distribution (Map 32-1). Peru (type locality).

Remarks. We have not seen specimens referable to this species. The holotype was not located in the sand fly collection of the National Institute of Health, Lima, in 1988.

## Lutzomyia (Trichophoromyia) rostrans (Summers)

Plate 32-28

Phlebotomus rostrans Summers 1912: 209 (♂, ♀, Rio Javari, Amazonas, Brazil). Barretto 1947: 221 (full refs.).

Lutzomyia rostrans: Barretto 1962: 97. Theodor 1965: 185 (listed). Lewis 1967a: 134 (♂, ♀, redescript.). Sherlock & Guitton 1970: 147 (♂ fig., keyed). Martins et al. 1978: 87 (refs., dist.).

Psychodopygus rostrans: Forattini 1971a: 105; 1973: 478 (in part, as senior synonym of octavioi).

Distribution (Map 32-7). Brazil (type locality).

Remarks. Lewis (1967a) carefully redescribed the holotype of L. rostrans, noting and illustrating character states that distinguish this male from L. octavioi. We have not examined this specimen, housed in the British Museum (Nat. Hist.), or others that can be assigned to this taxon. The type locality is presumed to be in Brazil, possibly near the Brazil-Peru border (Lewis 1967a).

Lutzomyia (Trichophoromyia) loretoensis (Llanos)

Plate 32-29

Phlebotomus loretonensis Llanos 1964: 375 (♂, Rosario, Loreto, Peru).

Lutzomyia loretonensis: Sherlock & Guitton 1970: 146 (♂ fig., keyed). Martins et al. 1978: 82 (refs., dist.). Llanos 1981: 183 (listed). Biancardi et al. 1982: 173 (Rondonia, Brazil).

Psychodopygus loretonensis: Forattini 1973: 472 (♂ fig., tax).

Distribution (Map 32-8). Peru (Martins et al. 1978); Brazil (Biancardi et al. 1982).

Remarks. We studied a male paratype of L. loretonensis (Pl. 32-29) from the type locality. There is a small, but distinct, proximal lobe on each paramere, not shown by Llanos (1964) or Forattini (1973).

Lutzomyia (Trichophoromyia) sp. 1 de Araracuara, Morales & Minter

Plate 32-30

Lutzomyia species 1 de Araracuara, Morales & Minter 1981: 102 (♂, ♀, Araracuara, Caqueta, Colombia).

Distribution (Map 32-6). Colombia (Morales & Minter 1981).

Remarks. This informally named species appears to be distinct from L. howardi. We examined several males through the courtesy of A. Morales, Bogota, and observed that the parameres of each had a distal row of long setae near the ventral margins. These setae are absent in L. howardi males. In other character states, the males are remarkably similar.

## Lutzomyia (Trichophoromyia) howardi Young

Plates 32-12 & 32-30

Lutzomyia howardi Young 1979: 144 (♂, Leticia, Amazonas, Colombia).

Distribution (Map 32-6). Colombia (type locality).

Remarks. The female of L. howardi is unknown. We have examined an additional male captured near Leticia, Colombia, in 1979 by R.C. Wilkerson.

## Lutzomyia (Trichophoromyia) ruii Arias & Young

Plate 32-31

Lutzomyia ruii Arias & Young 1982: 249 (♂, ♀, 26 km E of Manaus, Amazonas, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 107 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 32-4). Brazil (refs. given above).

Lutzomyia (Trichophoromyia) auraensis (Mangabeira)

Plate 32-5

Flebotomus auraensis Mangabeira 1942a: 161 (♂, Aurá, Belém. Pará, Brazil).

Lutzomyia auraensis: Barretto 1962: 97 (listed). Theodor 1965: 185 (♂, ♀ figs.). Sherlock & Guitton 1970: 144 (o fig., keyed). Martins et al. 1978: 84 (refs., dist.). Young 1979: 141 (♂ figs., full refs.). Fraiha et al. 1980b: 21 (? Peru). Biancardi et al. 1982: 175 (Rondonia, Brazil). Arias & Freitas 1982: 405 (Acre, Brazil). Hudson & Young 1985: 418 (Suriname). Young et al. 1985: 143 (Peru). Ryan 1986: 97 (♂ fig., Pará, Brazil).

Psychodopygus auraensis: Forattini 1973: 416 (figs., tax.).

Distribution (Map 32-7). Suriname (Hudson & Young 1985); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Frietas 1982; Ryan 1986); Peru (Young et al. 1985; other records are questionable, i.e., Llanos 1964; 1981; Fraiha et al. 1980b). Bolivia (Young 1979); Colombia (Young 1979).

Remarks. Llanos (1964) identified and illustrated a Lutzomyia (Trichophoromyia) male from Dos de Mayo, Loreto Department, Peru, that she misidentified as L. auraensis. We have not examined these Peruvian males, but from her description they appear to represent a new taxon.

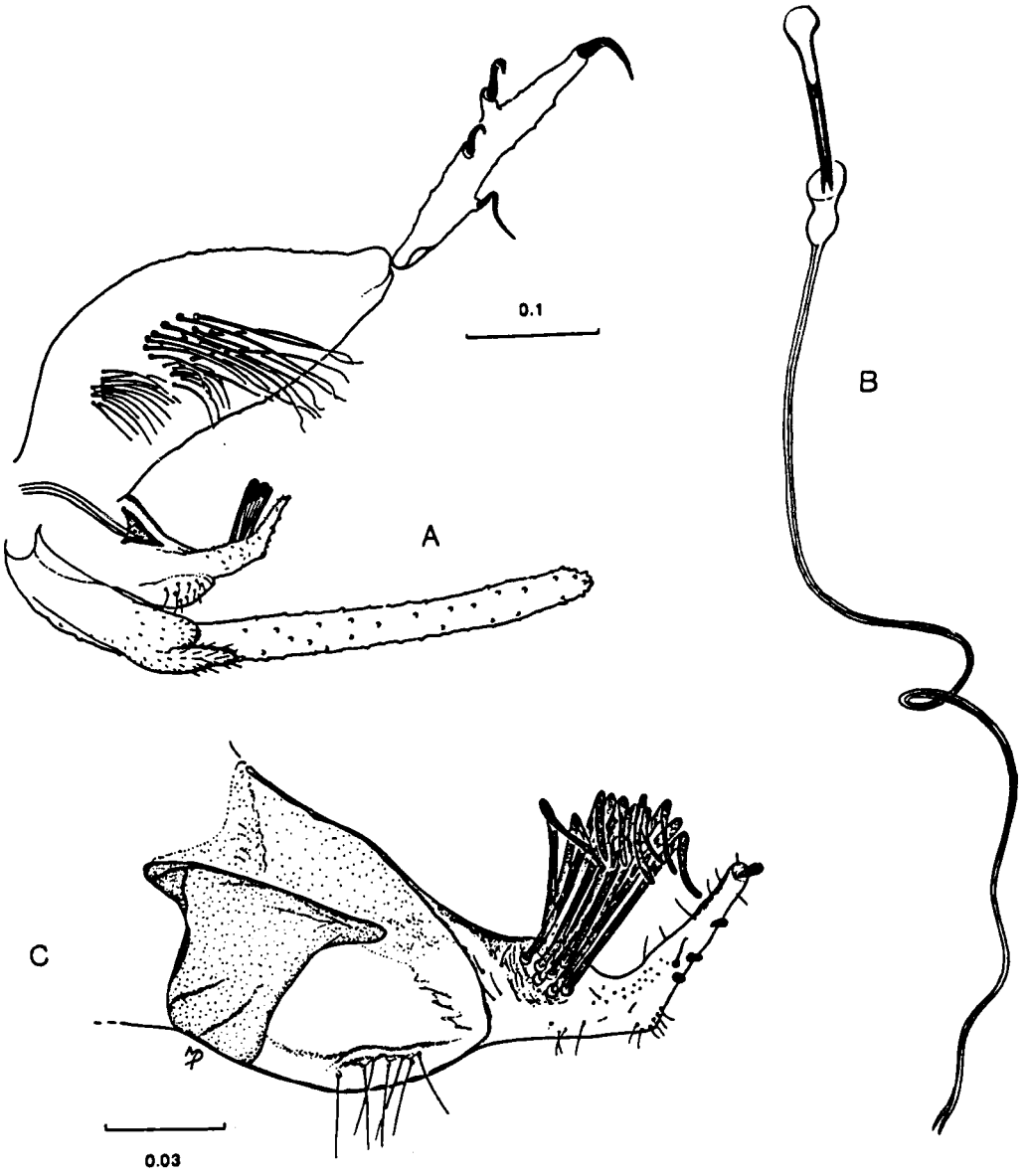



Plate 32-1

Lutzomyia (Trichophoromyia) n. sp. #3. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

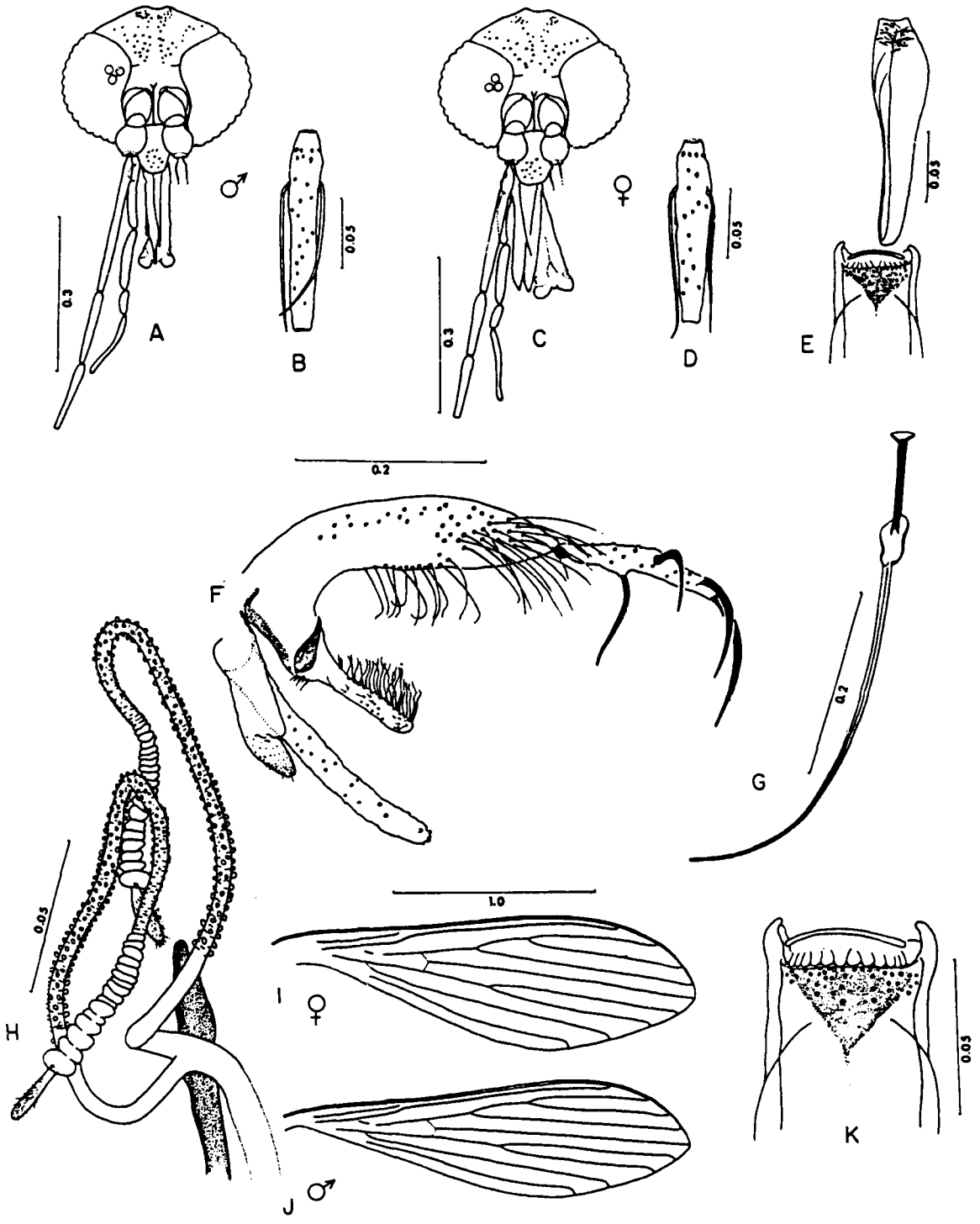



Plate 32-2

Lutzomyia reburra. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium.

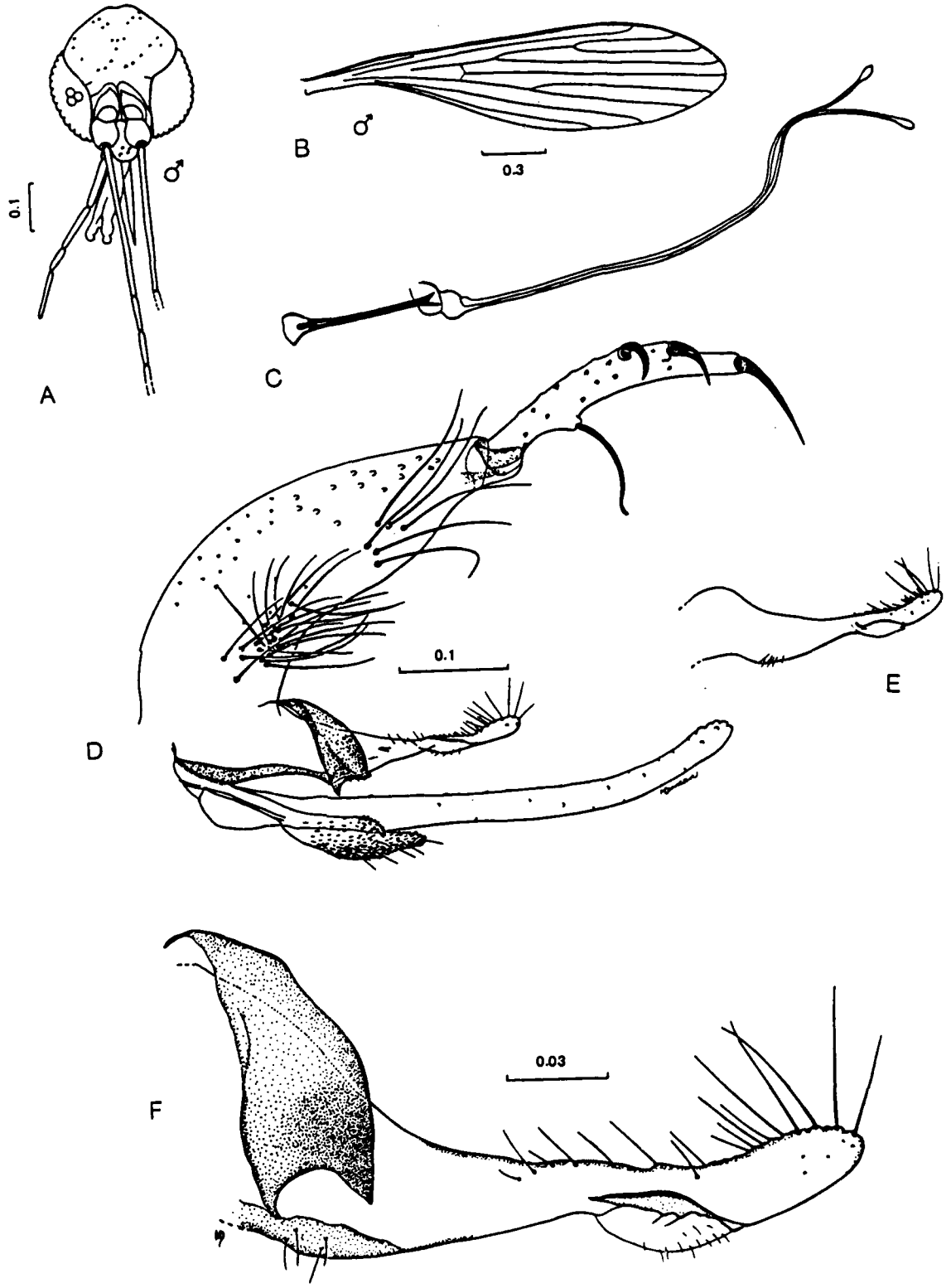



Plate 32-3

Lutzomyia meirai. A. Male head; B. Male wing; C. Genital pump & filaments; D. Male terminalia; E. Paramere; F. Paramere & aedeagus.

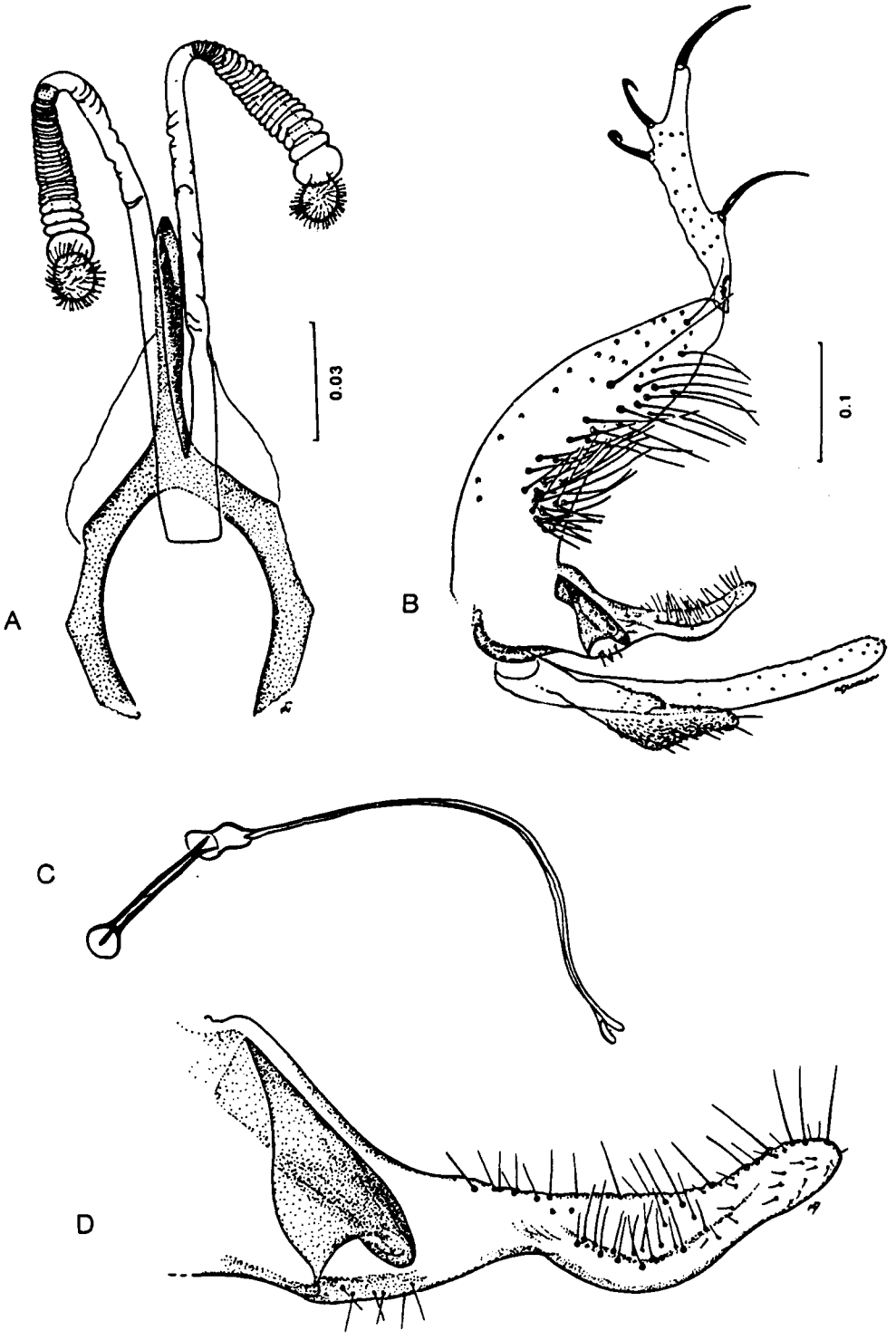



Plate 32-4

Lutzomyia omagua. A. Spermathecae; B. Male terminalia; C. Genital pump & filaments; D. Paramere & aedeagus.

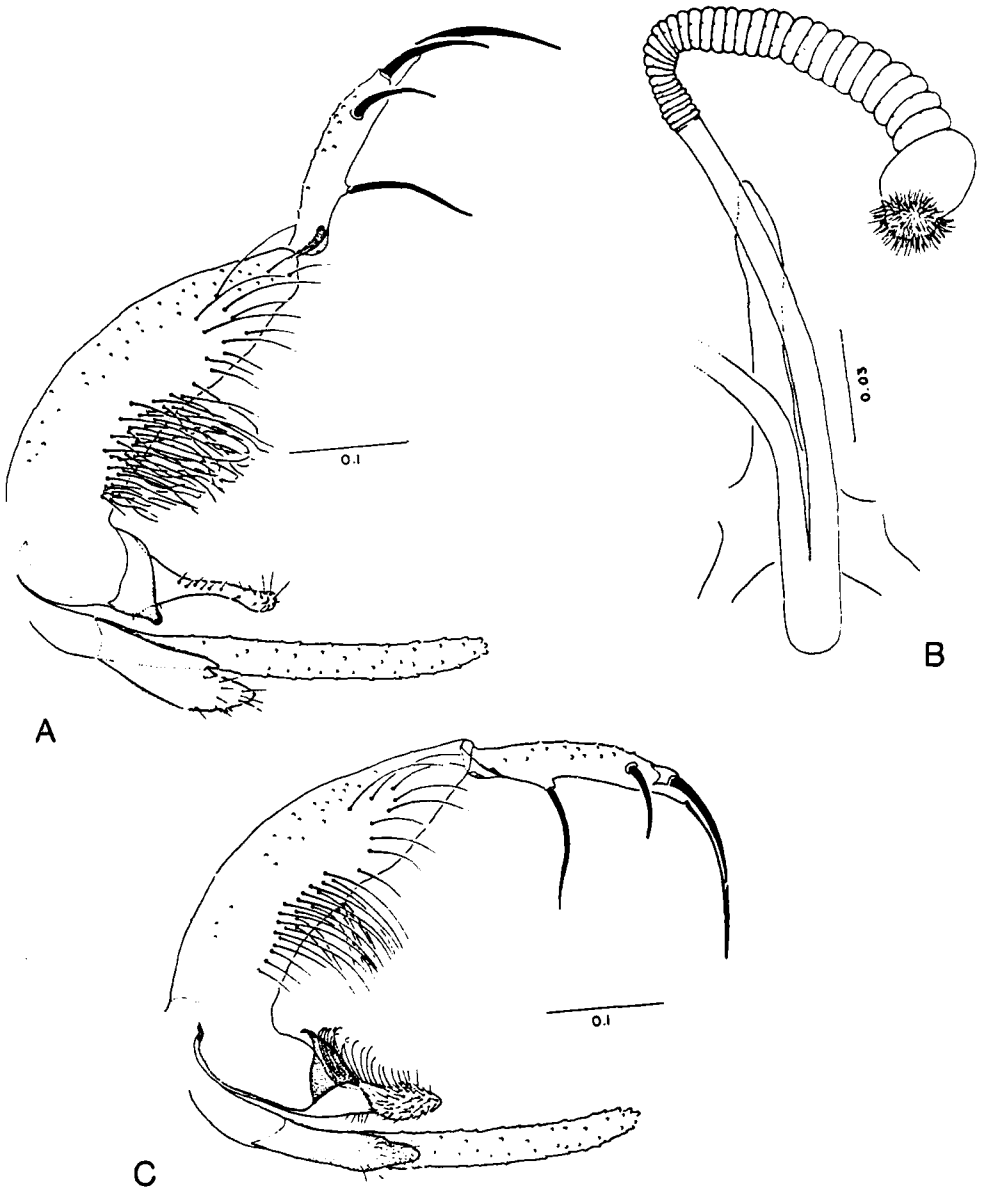



Plate 32-5

Lutzomyia ubiquitalis. A. Male terminalia; B. Spermatheca (fig. A from Young 1979; B from Arias & Young 1982).

Lutzomyia auraensis. C. Male terminalia (from Young 1979).

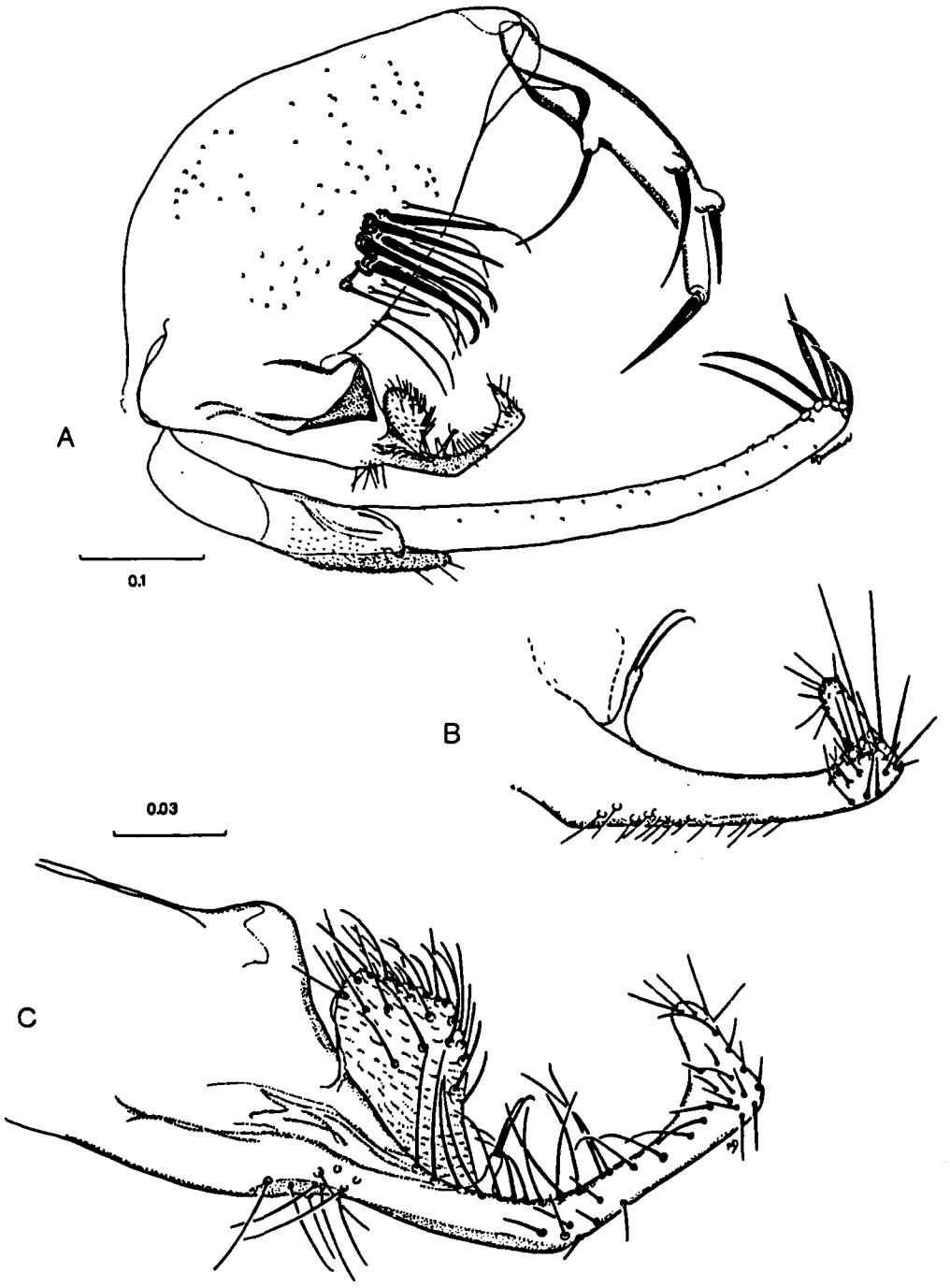



Plate 32-6

Lutzomyia (Trichophoromyia) n.sp. #4. A. Male terminalia; B. Paramere; C. Paramere.

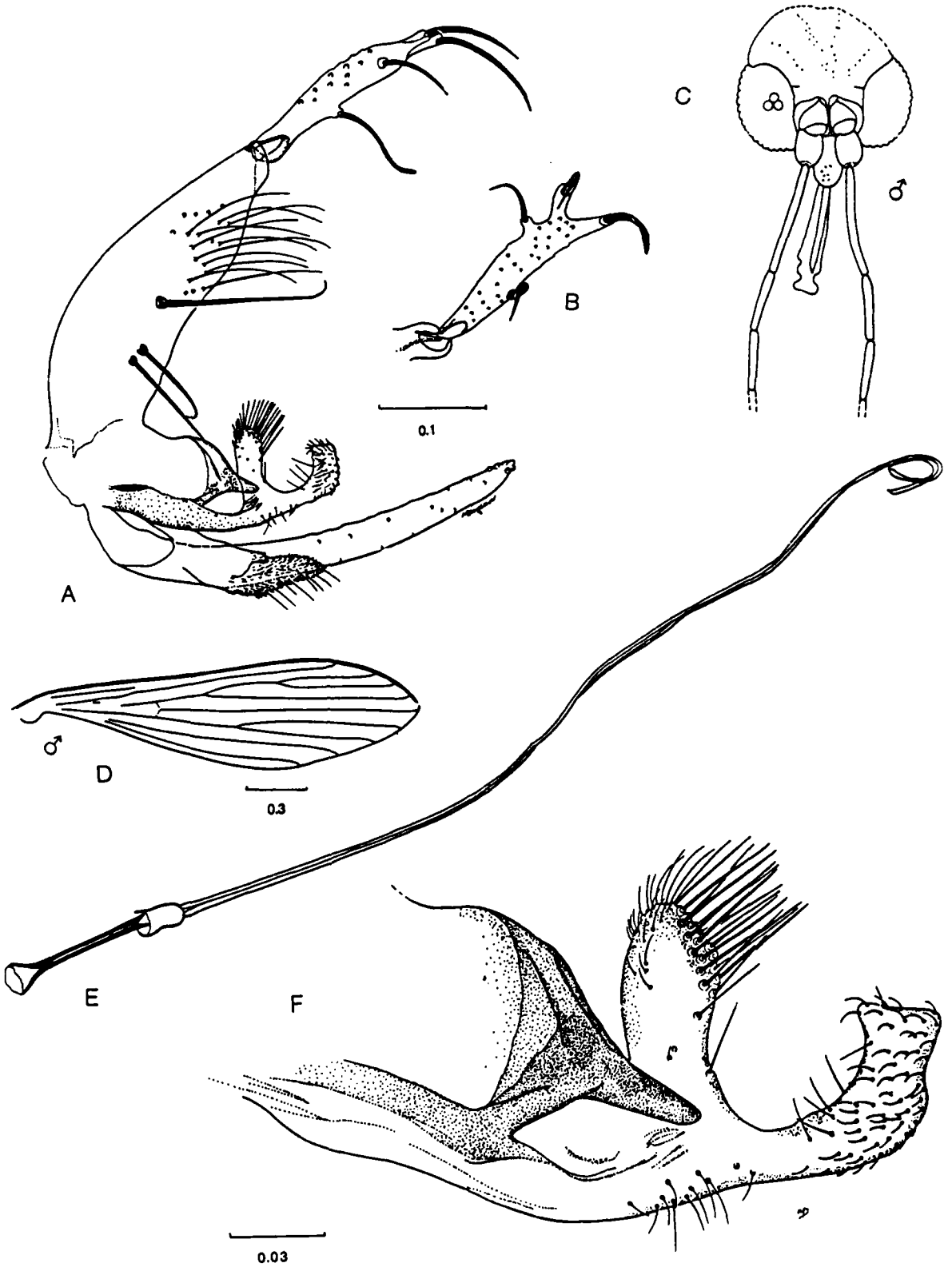



Plate 32-7

Lutzomyia dunhami. A. Male terminalia; B. Style; C. Male head; D. Male wing; E. Genital pump & filaments; F. Paramere & aedeagus.

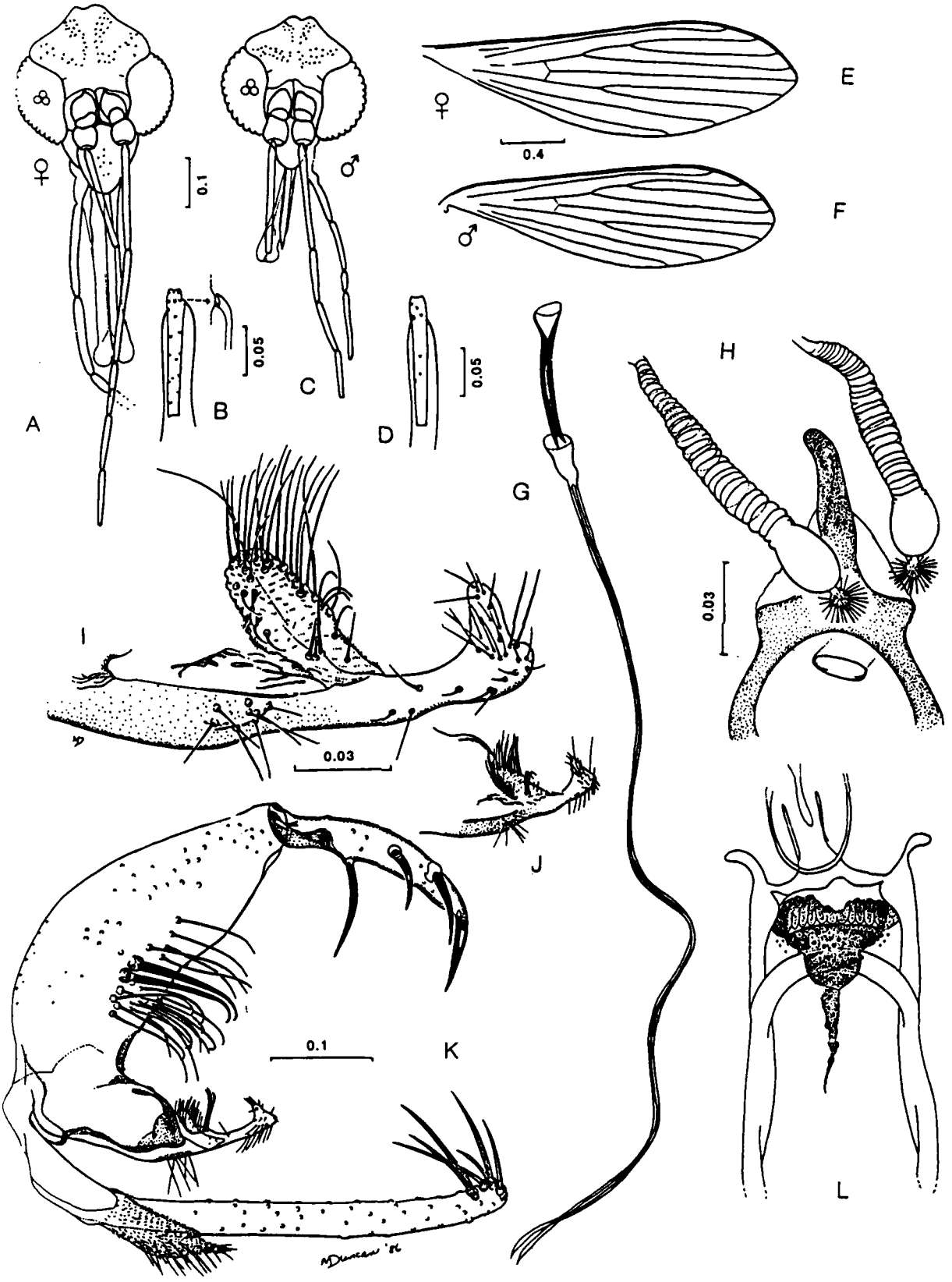



Plate 32-8

Lutzomyia viannamartinsi. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Spermathecae; I. Paramere; J. Paramere; K. Male terminalia.

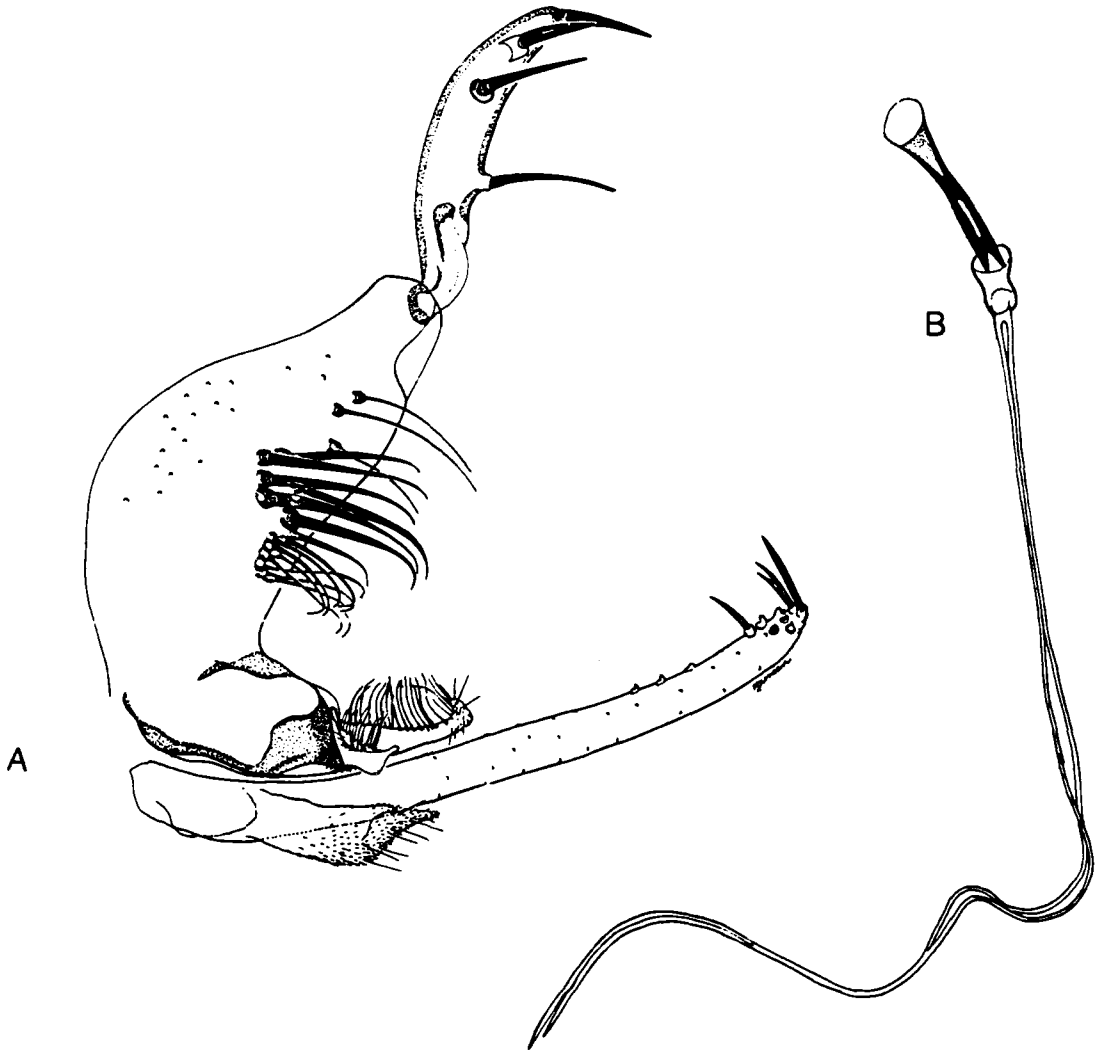



Plate 32-9

Lutzomyia brachipyga. A. Male terminalia; B. Genital pump & filaments.

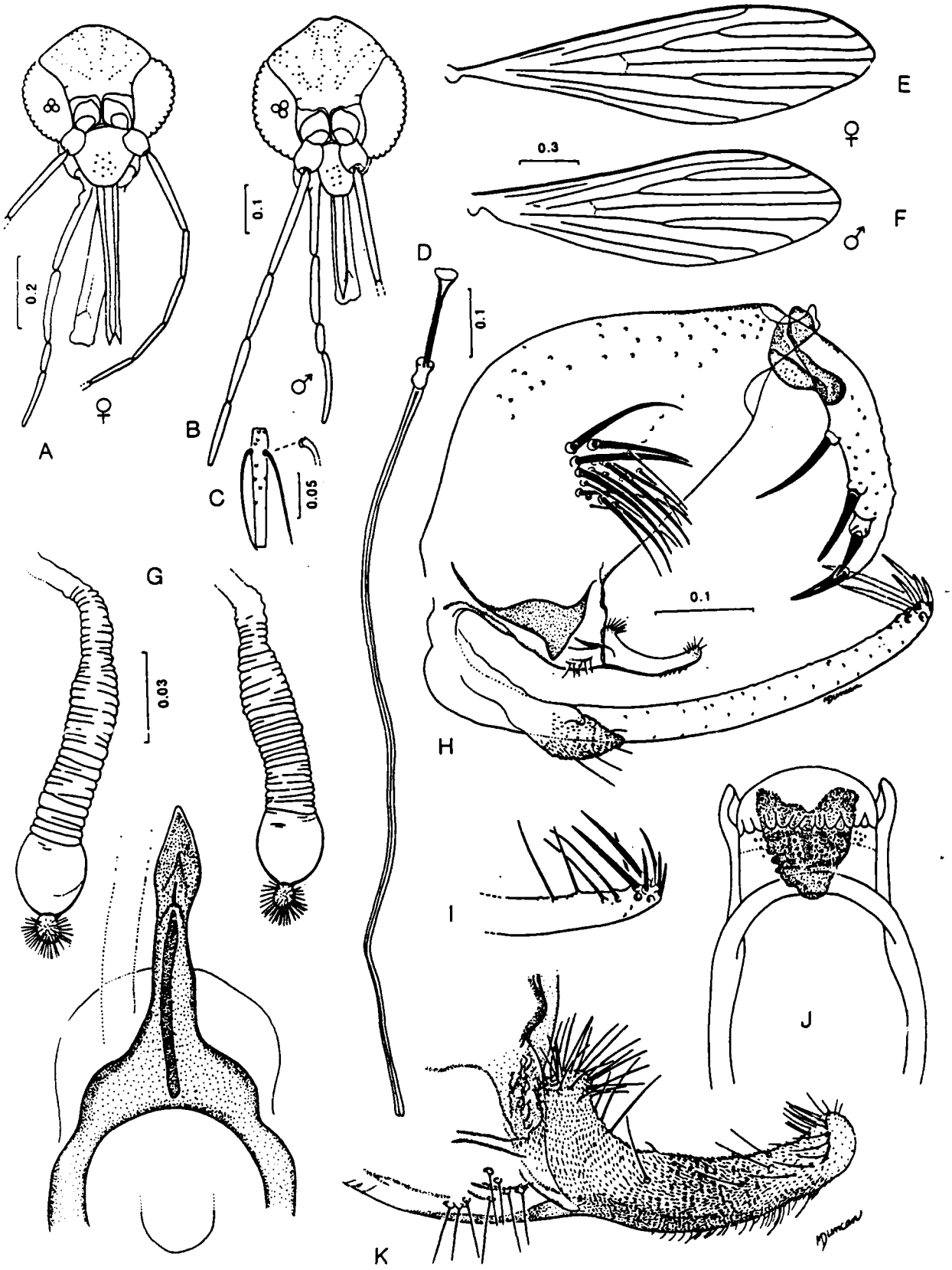



Plate 32-10

Lutzomyia (Trichophoromyia) n.sp. #5. A. Female head; B. Male head; C. Male flagellomere II; D. Genital pump & filaments; E. Female wing; F. Male wing; G. Spermathecae; H. Male terminalia; I. End of lateral lobe; J. Female cibarium; K. Paramere.

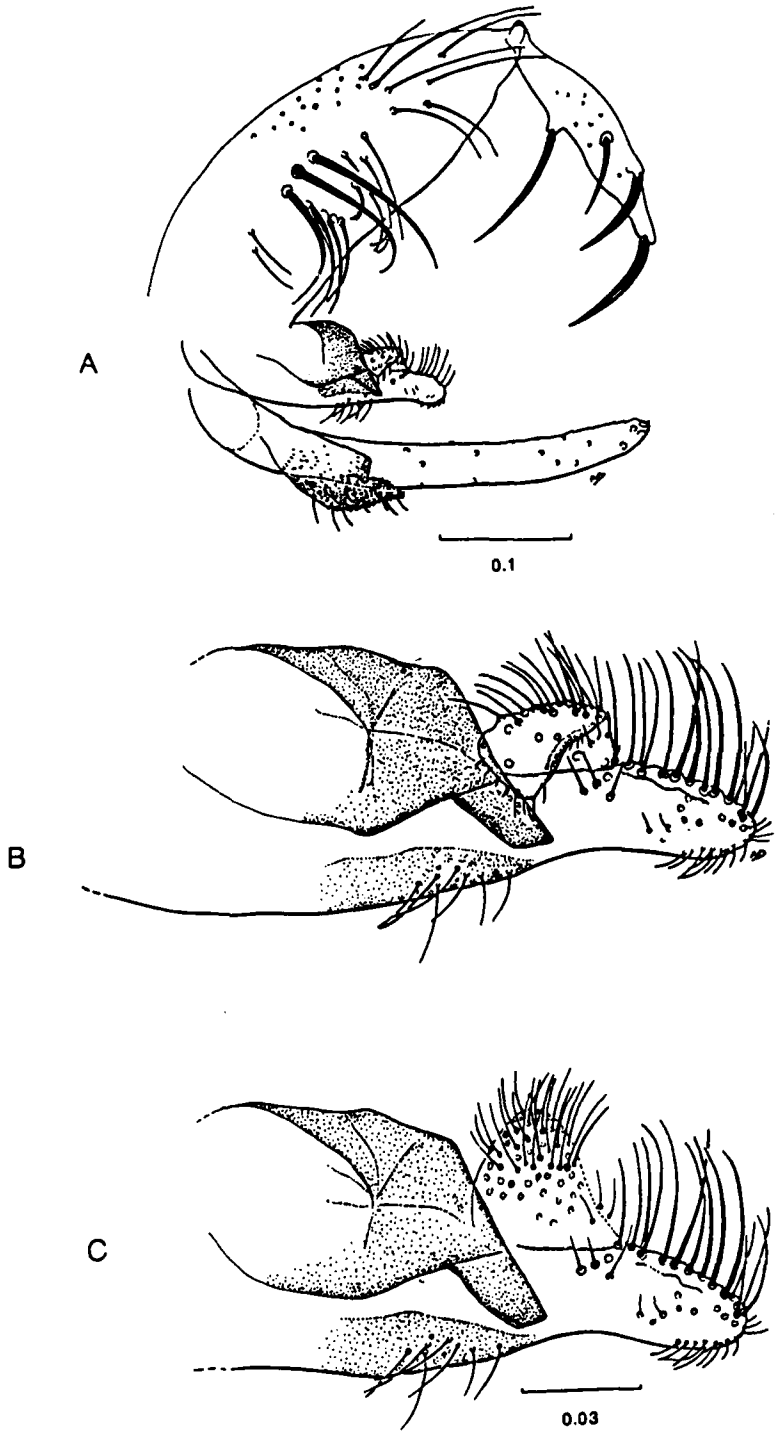



Plate 32-11

Lutzomyia readyi. A. Male terminalia; B. Paramere showing dorsal lobe & aedeagus; C. Paramere with dorsal lobe in natural position (schematic).

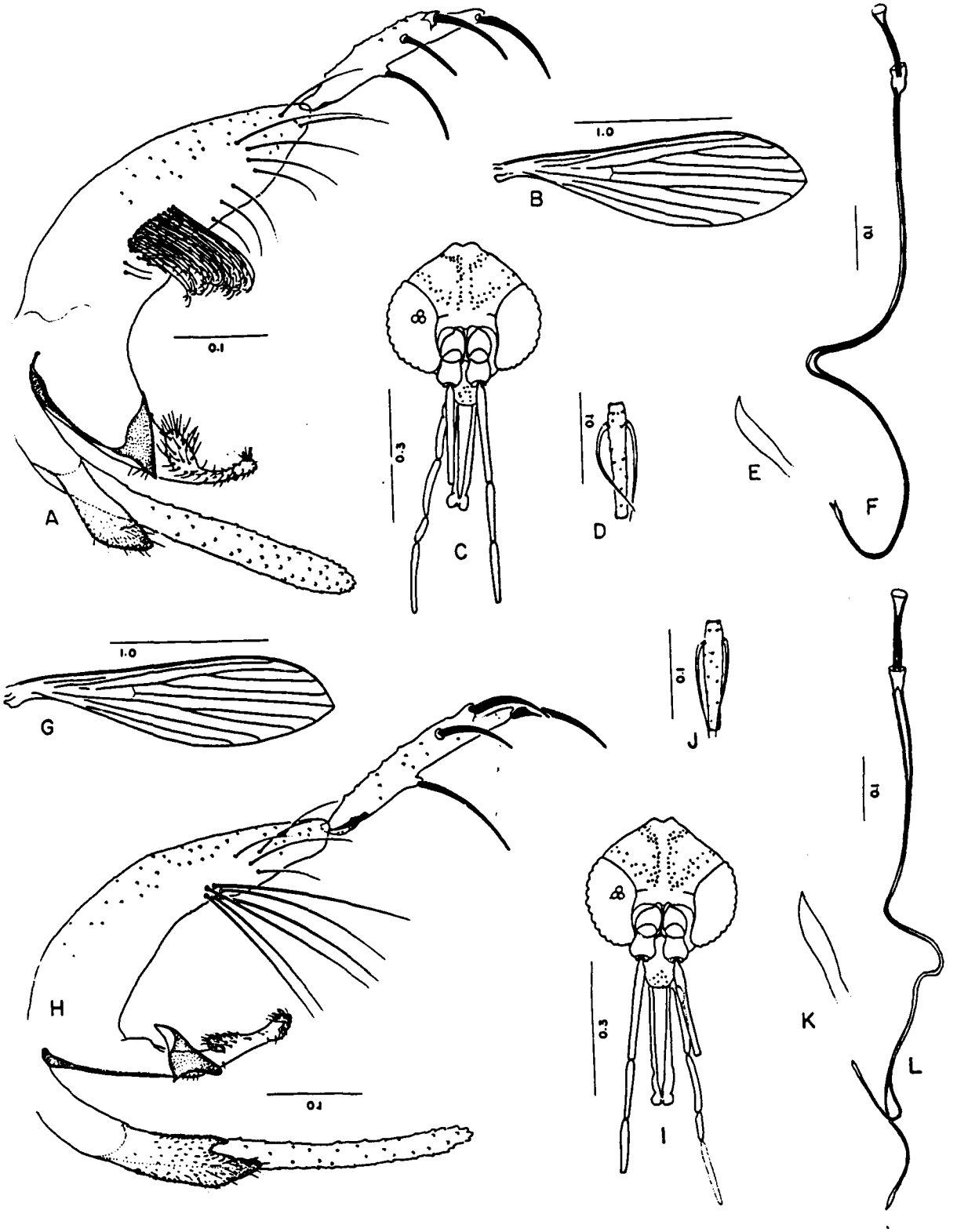



Plate 32-12

Lutzomyia howardi. A. Male terminalia; B. Male wing; C. Male head; D. Male flagellomere II; E. Tip of genital filament; F. Genital pump & filaments (from Young 1979).

Lutzomyia saltuosa. G. Male wing; H. Male terminalia; I. Male head; J. Male flagellomere II; K. Tip of genital filament; L. Genital pump & filament.

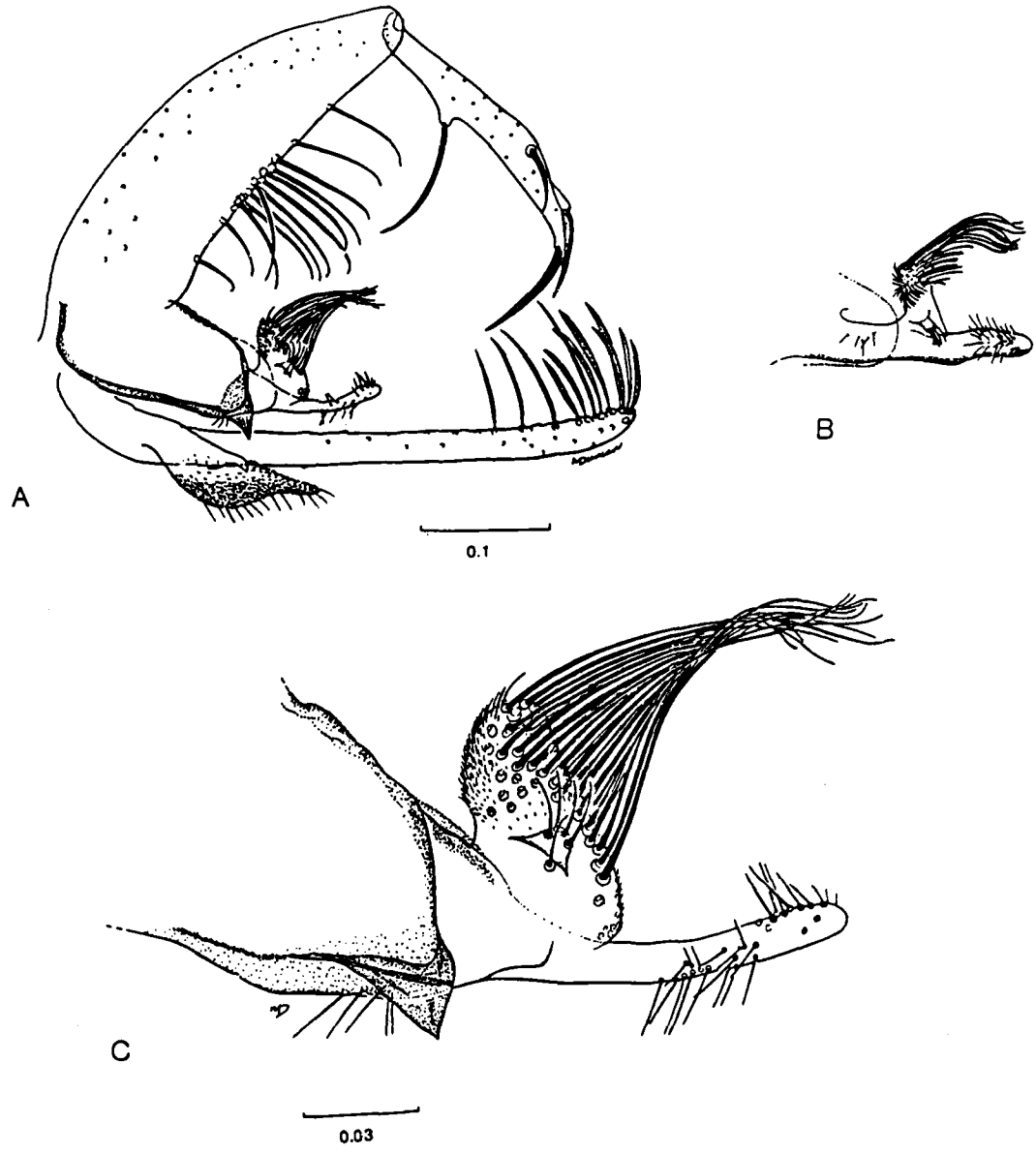



Plate 32-13

Lutzomyia castanheirai. A. Male terminalia; B. Paramere (different aspect); C. Paramere & aedeagus.

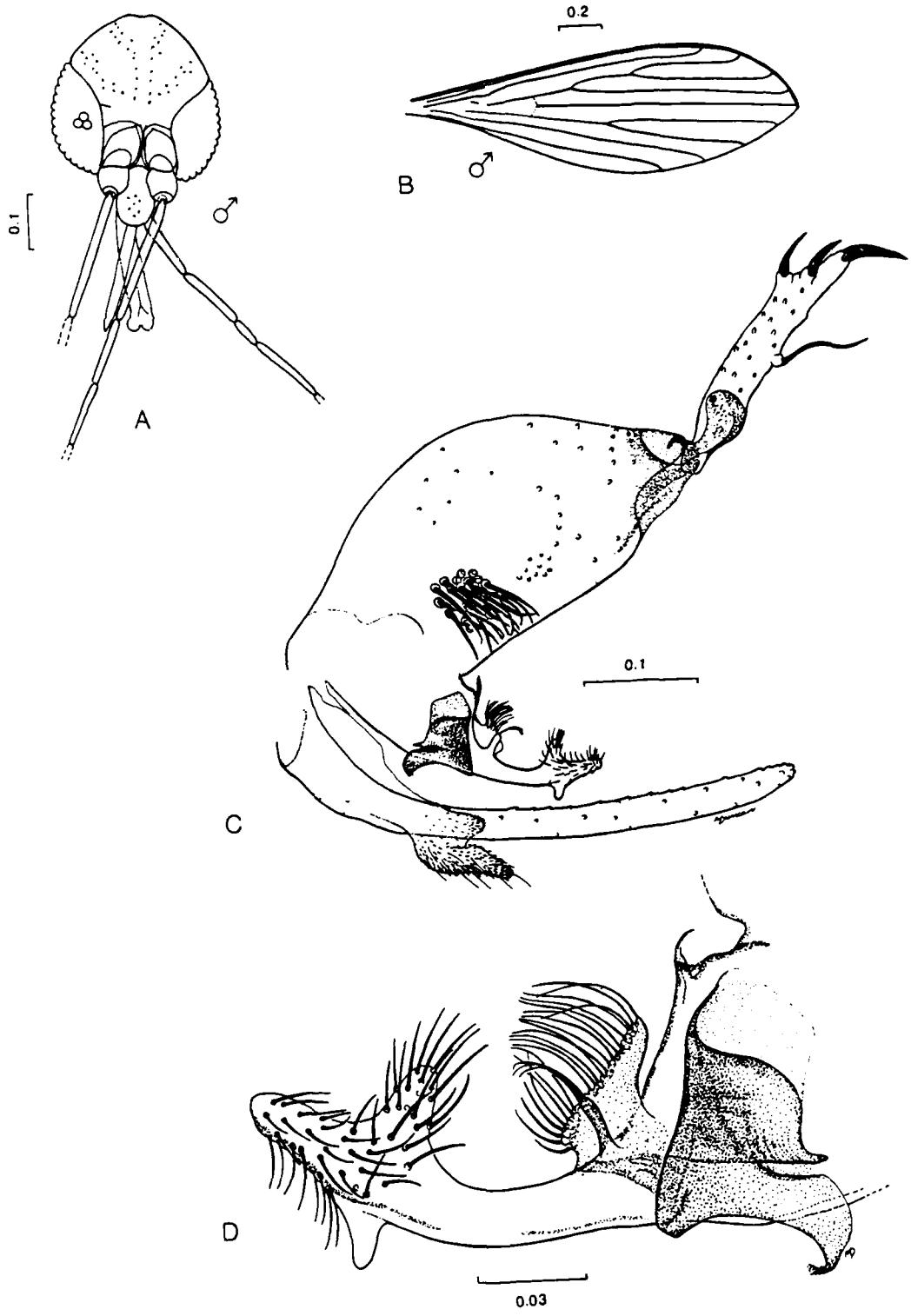



Plate 32-14

Lutzomyia lopesi. A. Male head; B. Male wing; C. Male terminalia; D. Paramere.

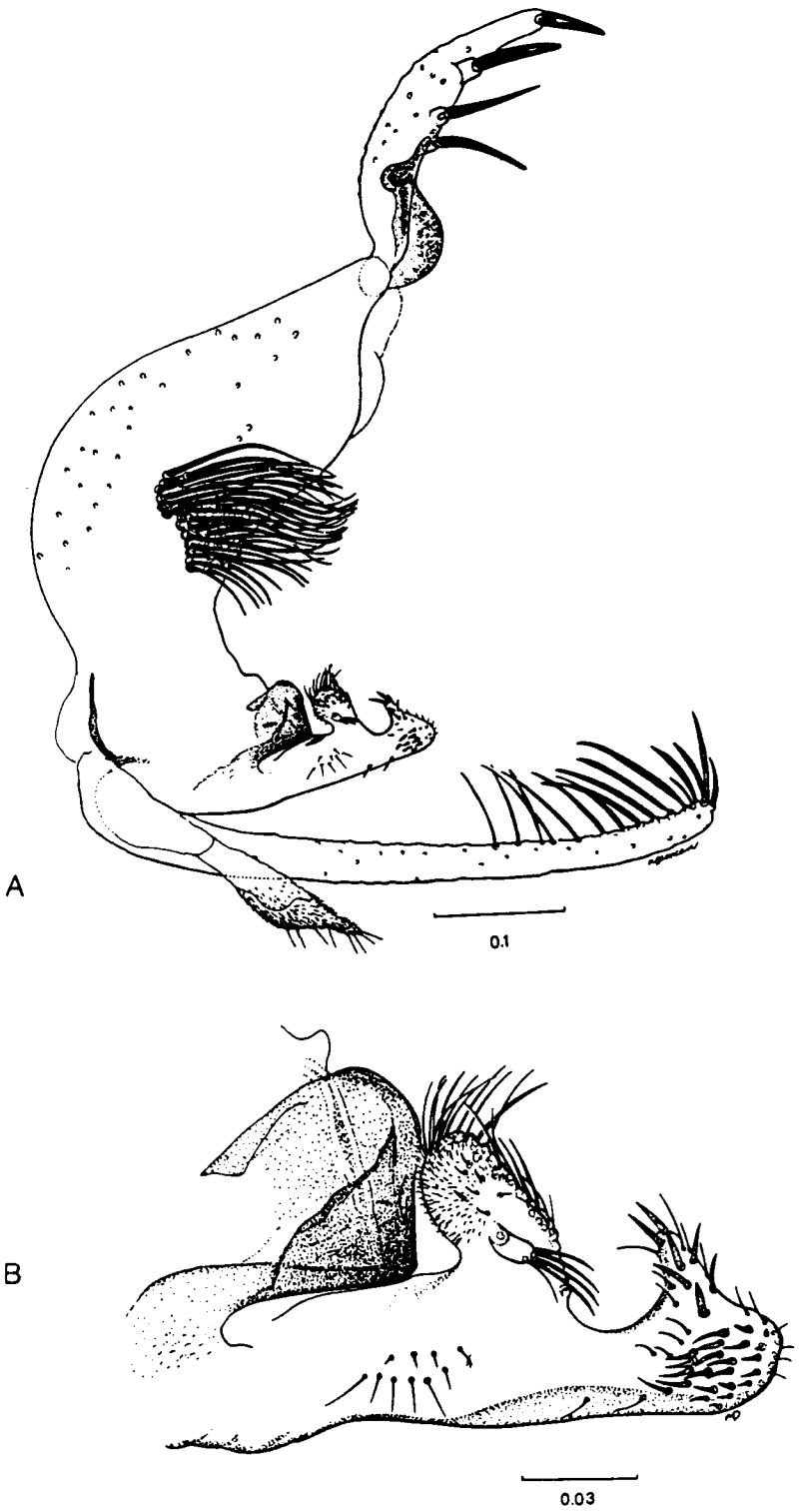



Plate 32-15

Lutzomyia eurypyga. A. Male terminalia; B. Paramere.

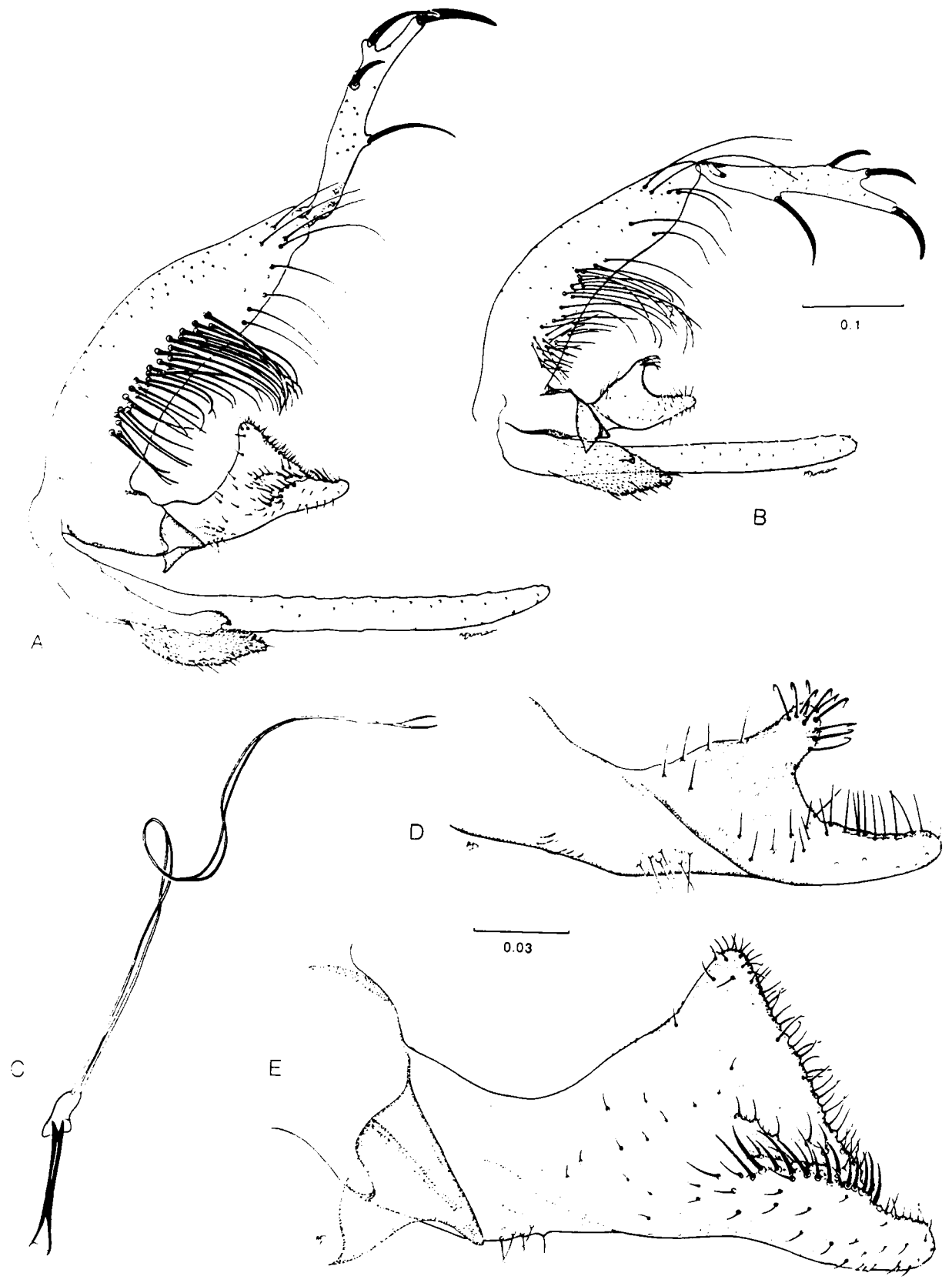



Plate 32-16

Lutzomyia innini. A. Male terminalia; E. Paramere & aedeagus.

Lutzomyia melloi. B. Male terminalia; C. Genital pump & filaments; D. Paramere.

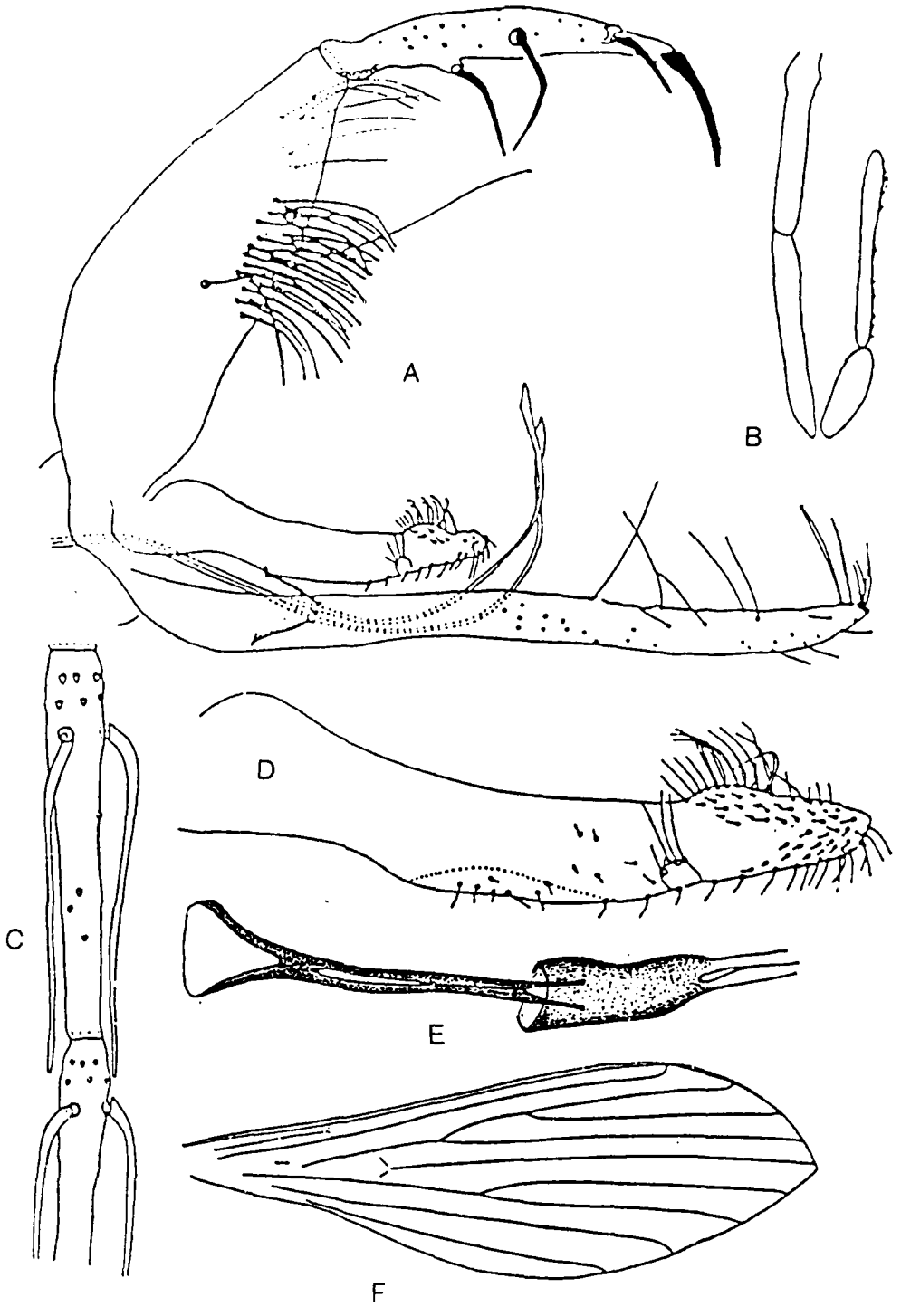



Plate 32-17

Lutzomyia acostai. A. Male terminalia; B. Palpus; C. Flagellomeres showing ascoids; D. Paramere; E. Genital pump; F. Male wing (all figs. from Llanos 1964).

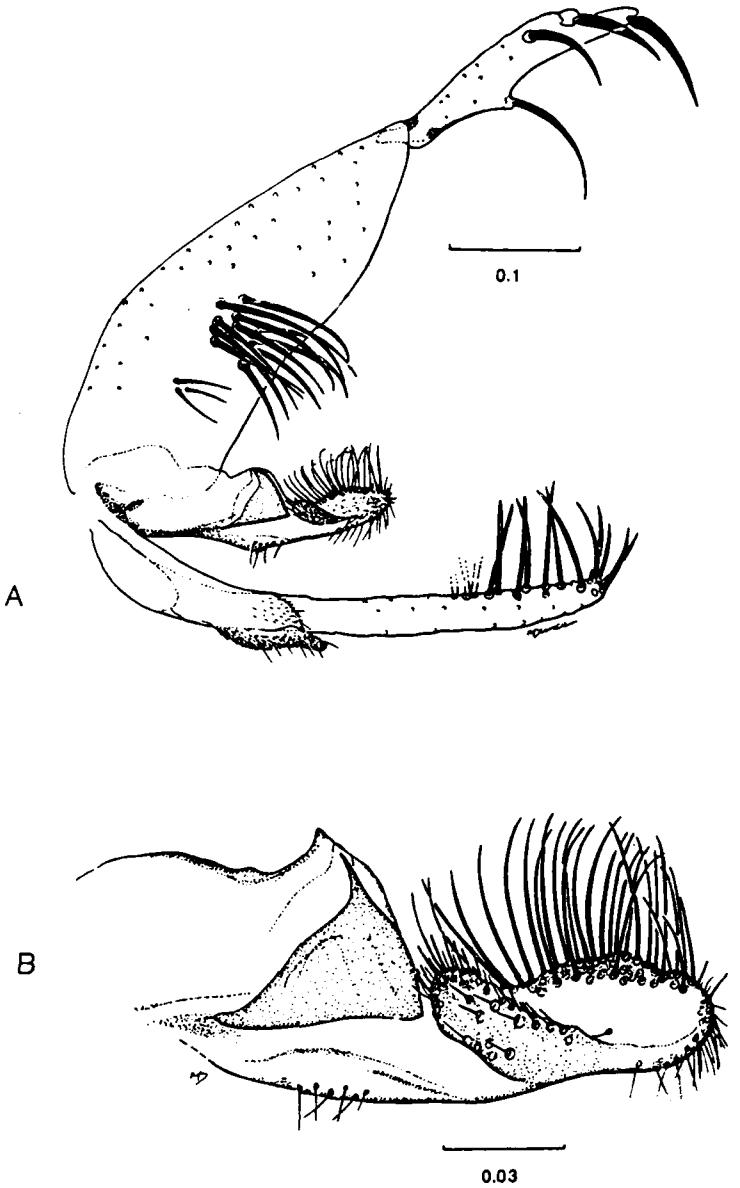



Plate 32-18

Lutzomyia flochi. A. Male terminalia; B. Paramere.

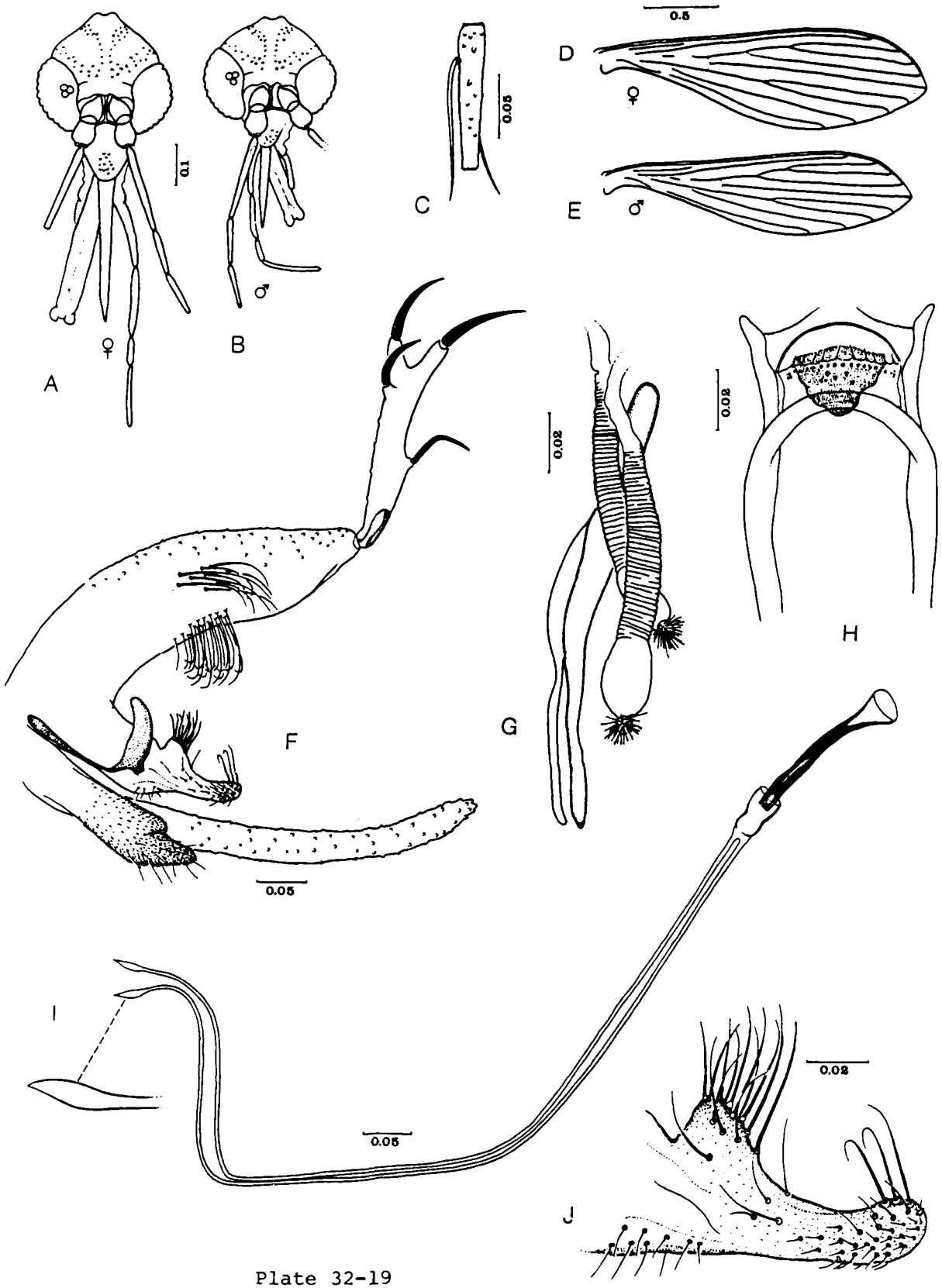



Plate 32-19

Lutzomyia napoensis. A. Female head; B. Male head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male terminalia; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Paramere (figs. from Young & Rogers 1984).

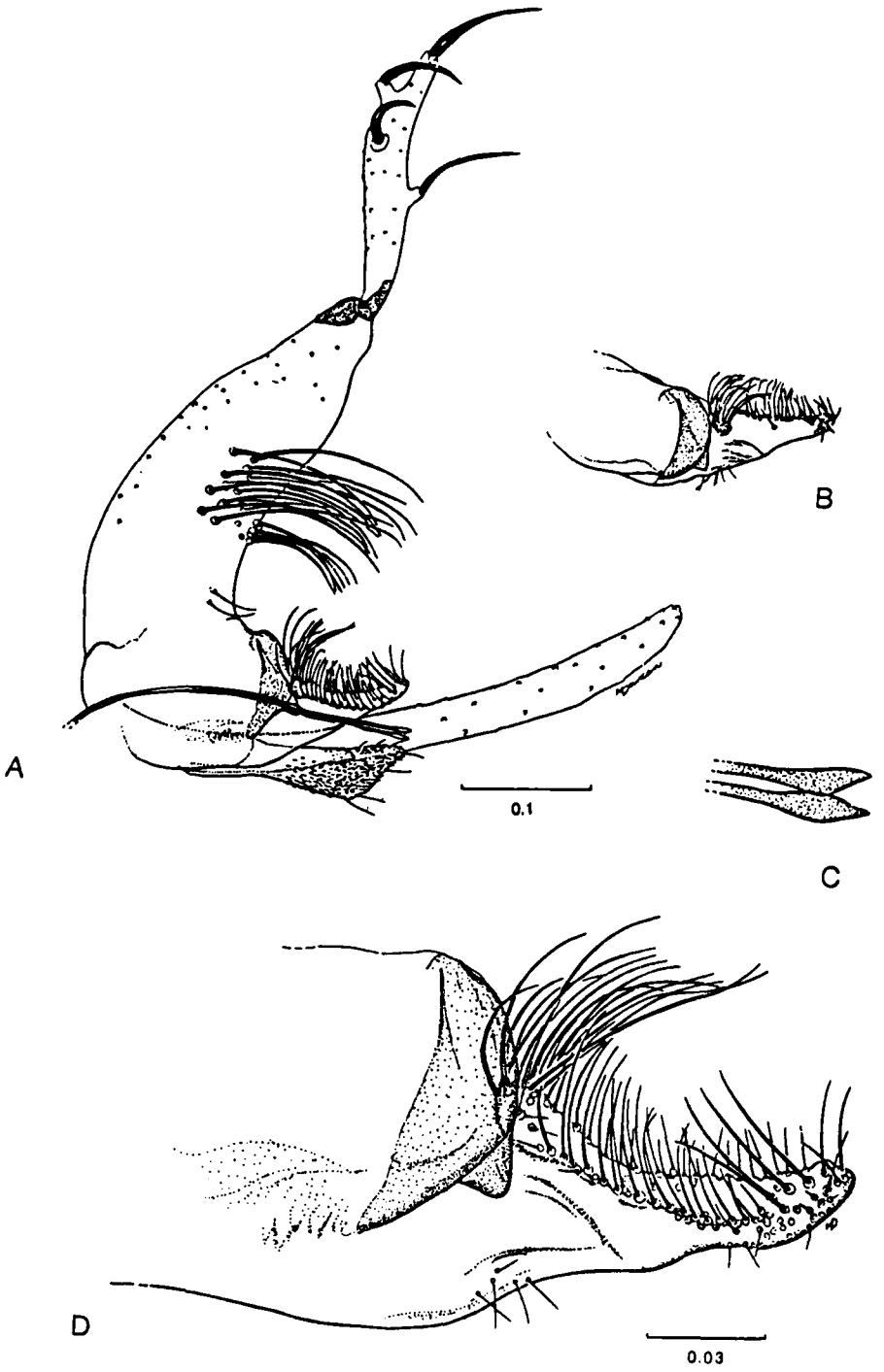



Plate 32-20

Lutzomyia (Trichophoromyia) n.sp. #6. A. Male terminalia; B. Paramere; C. Tips of genital filaments; D. Paramere.

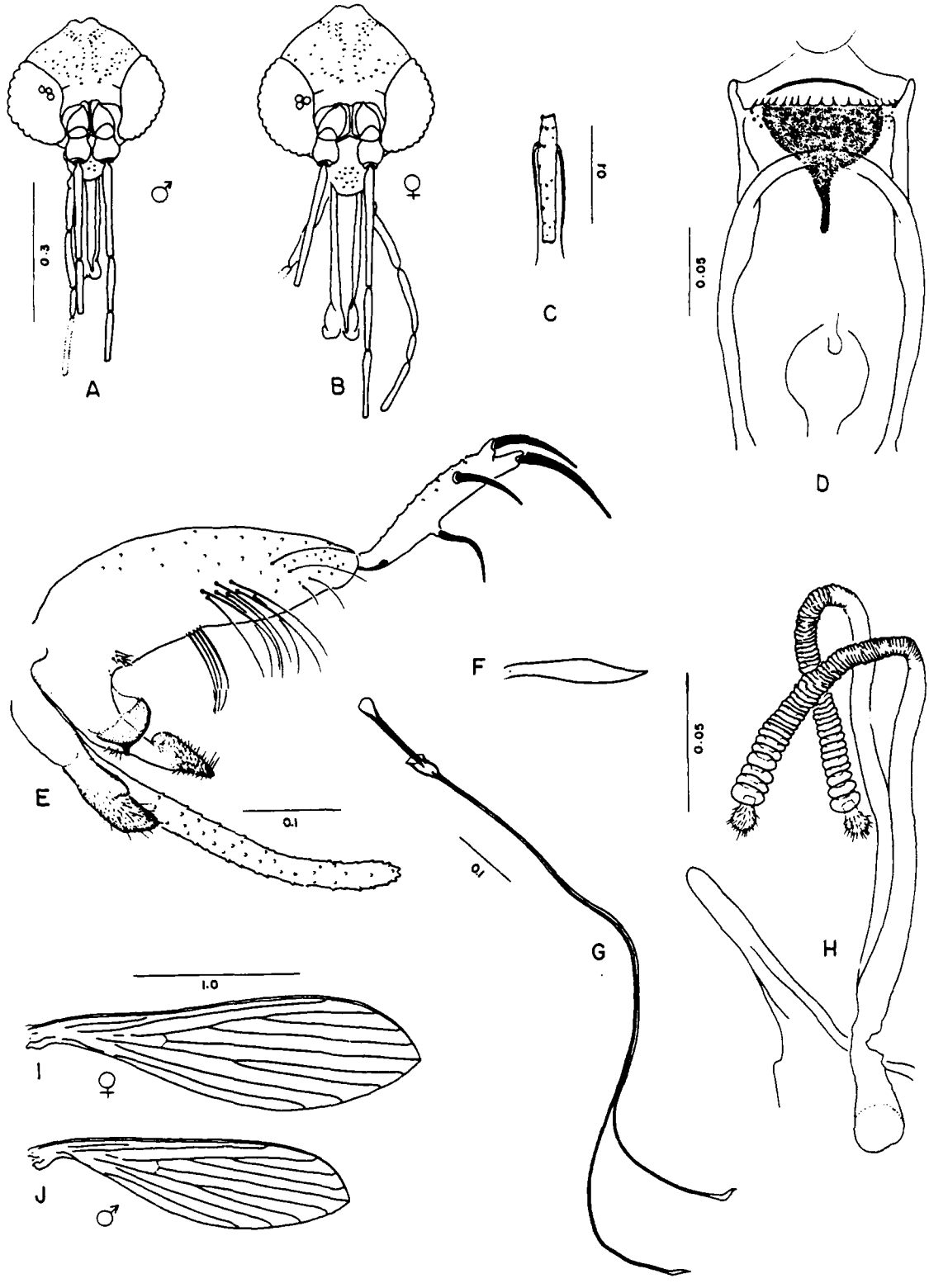



Plate 32-21

Lutzomyia cellulana. A. Male head; B. Female head; C. Female flagellomere II; D. Female cibarium; E. Male terminalia; F. Tip of genital filament; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing (figs. from Young 1979).

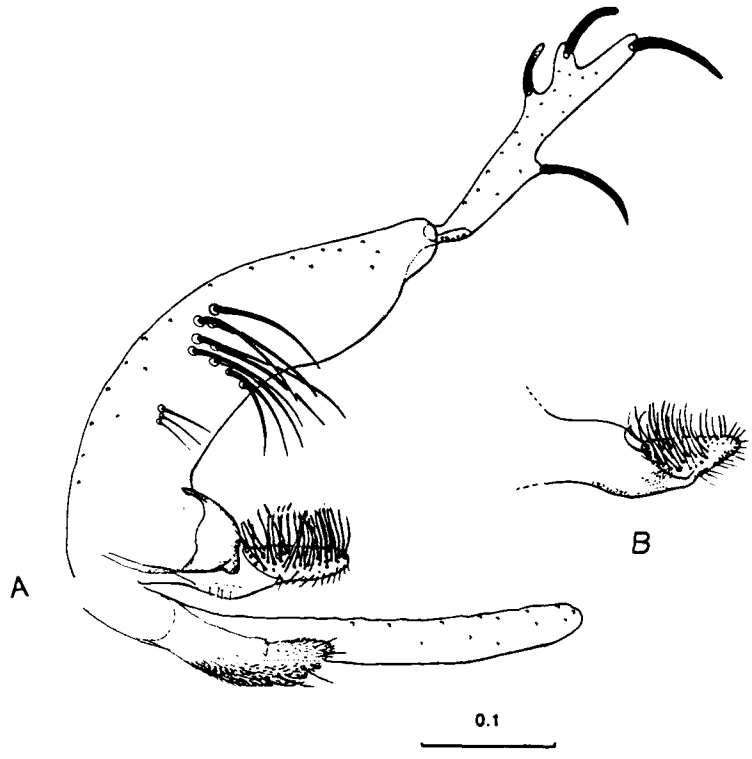



Plate 32-22

Lutzomyia octavioi. A. Male terminalia; B. Paramere.

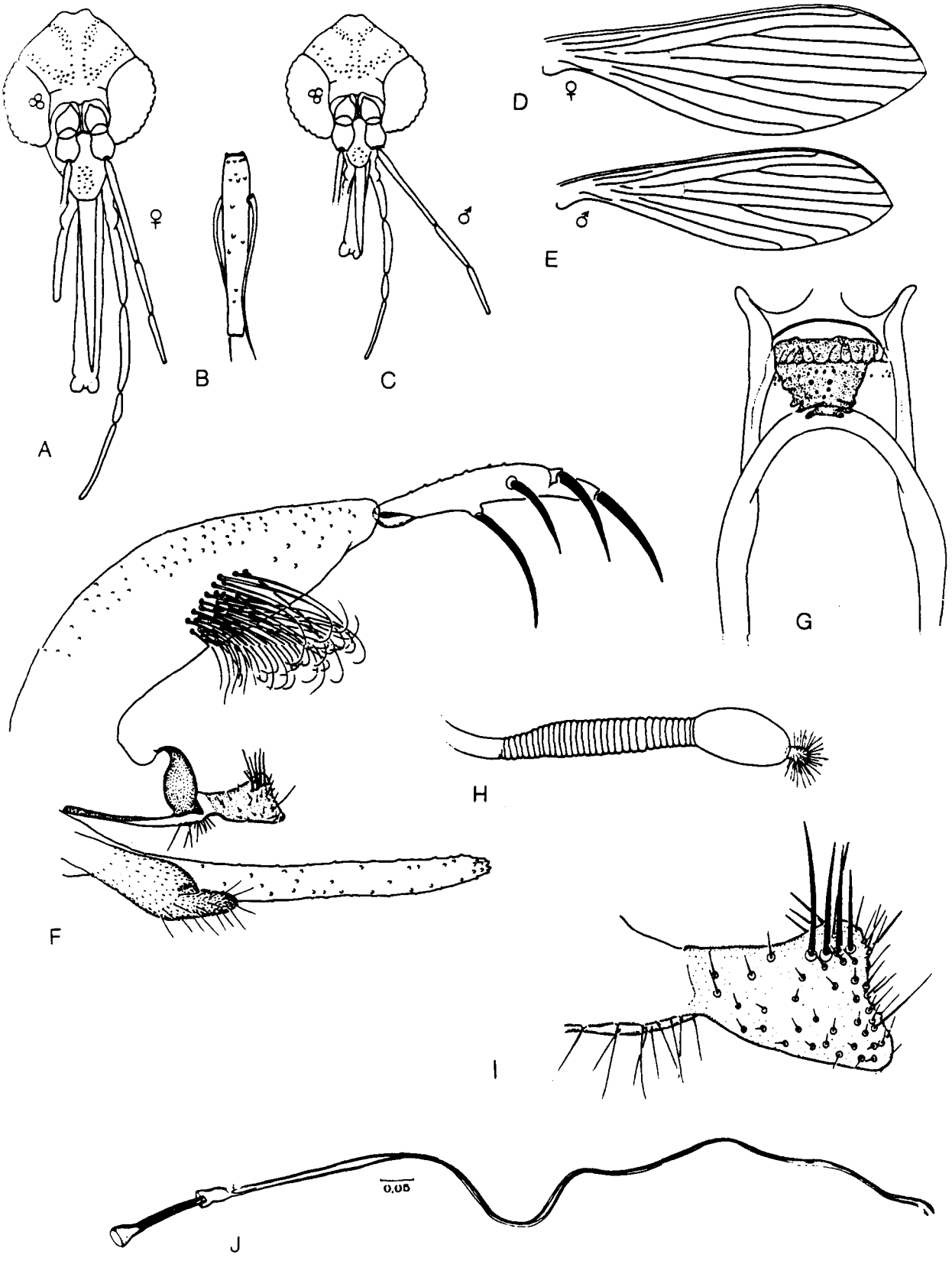



Plate 32-23

Lutzomyia wilkersoni. A. Female head; B. Female flagellomere II; C. Male head; D. Female wing; E. Male wing; F. Male terminalia; G. Female cibarium; H. Spermatheca; I. Paramere; J. Genital pump & filaments (figs. from Young & Rogers 1984).

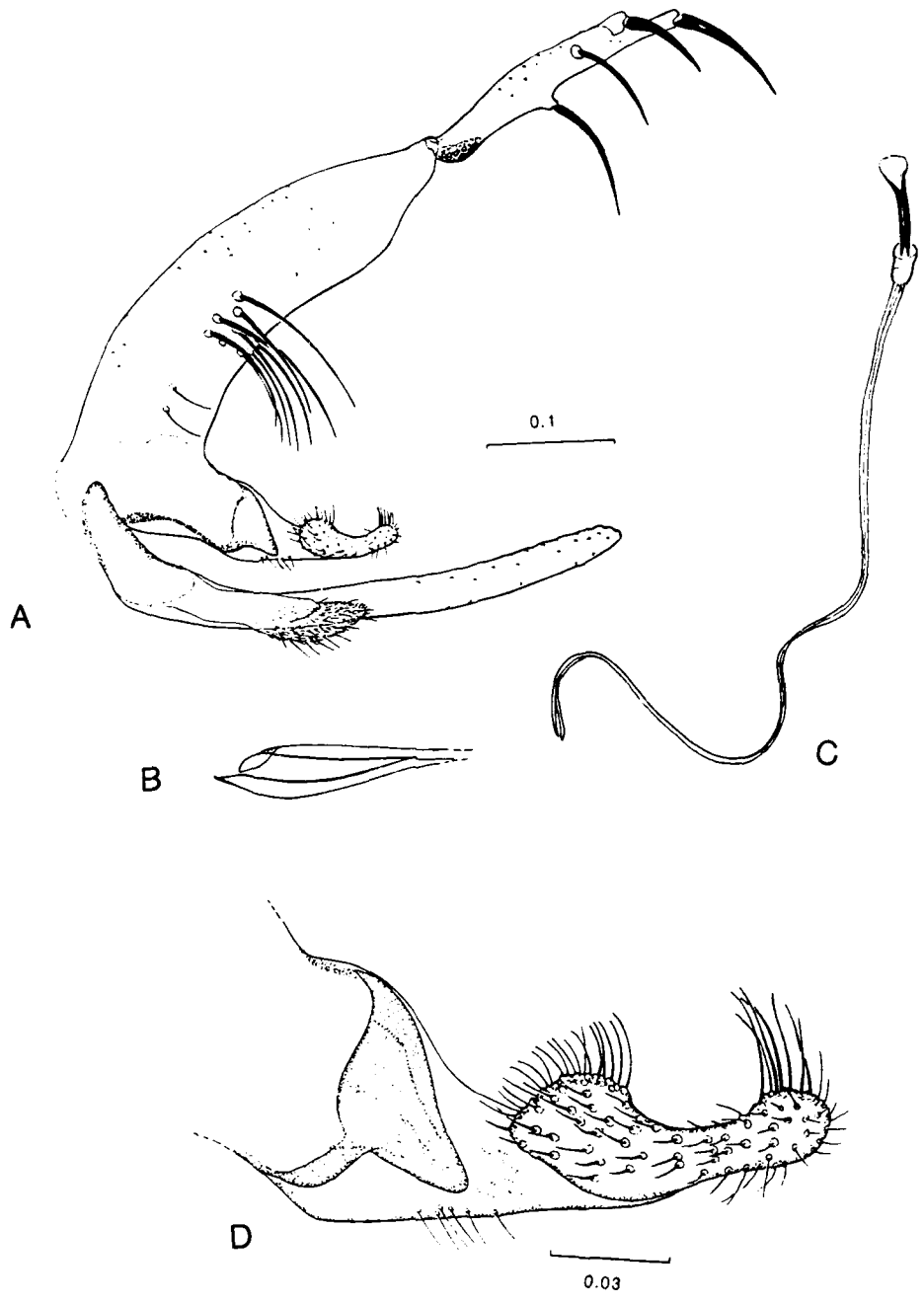



Plate 32-24

Lutzomyia (Trichophoromyia) n.sp. #2. A. Male terminalia; B. Tips of genital filaments; C. Genital pump & filaments; D. Paramere.

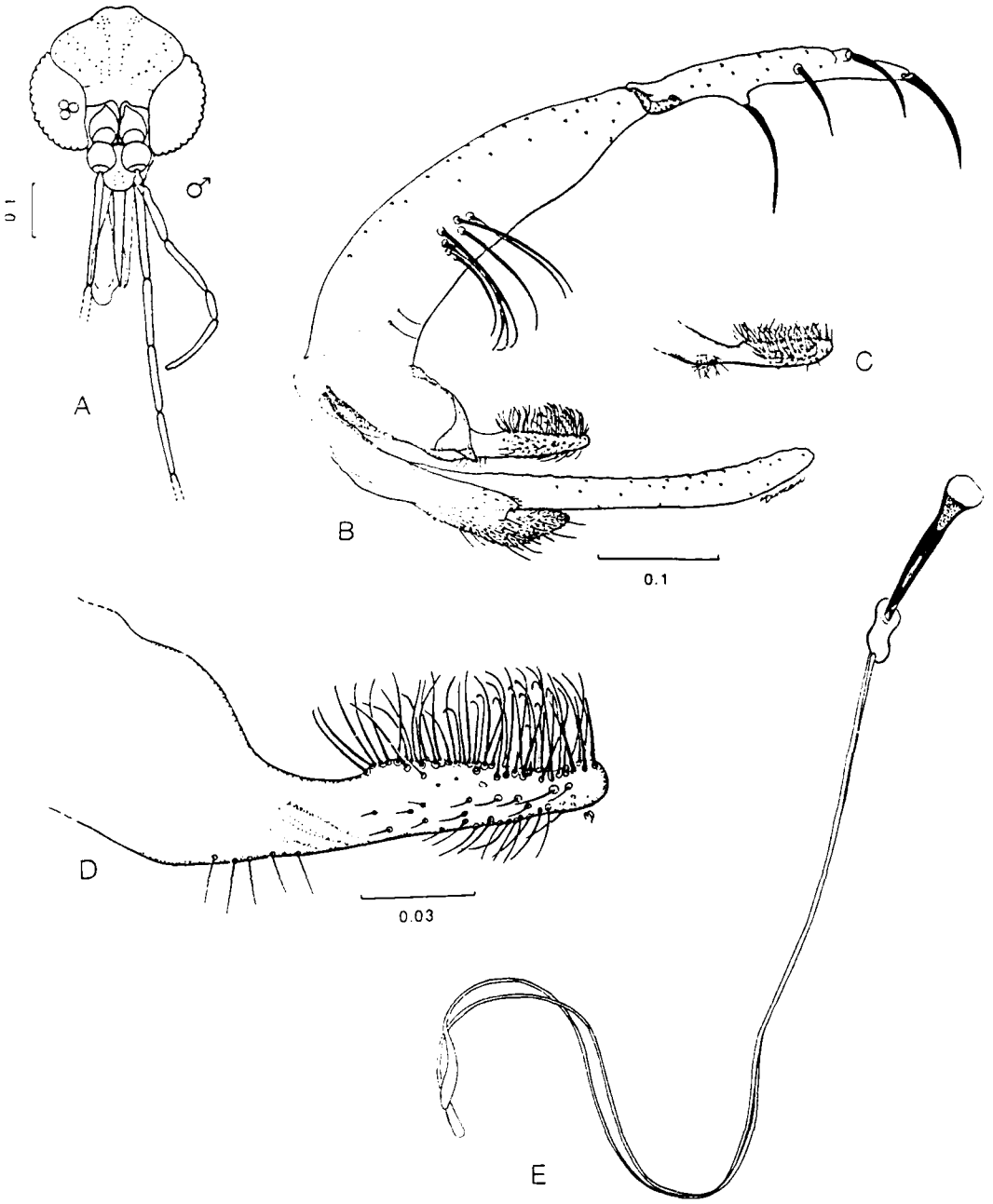



Plate 32-25

Lutzomyia (Trichophoromyia) n. sp. #1. A. Male head; B. Male terminalia; C. Paramere; D. Paramere; E. Genital pump & filaments.

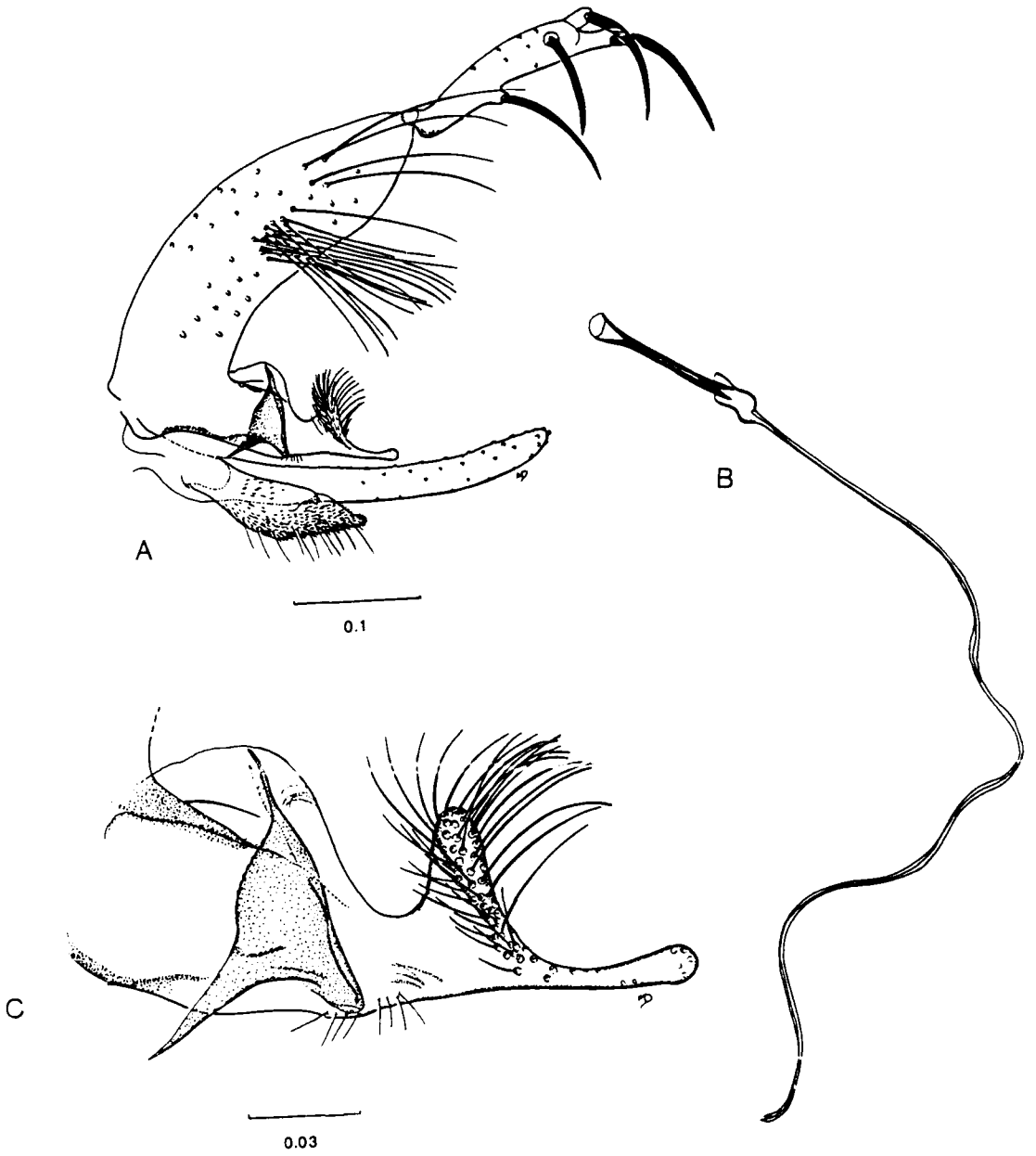



Plate 32-26

Lutzomyia beniensis. A. Male terminalia; B. Genital pump & filaments; C. Paramere.

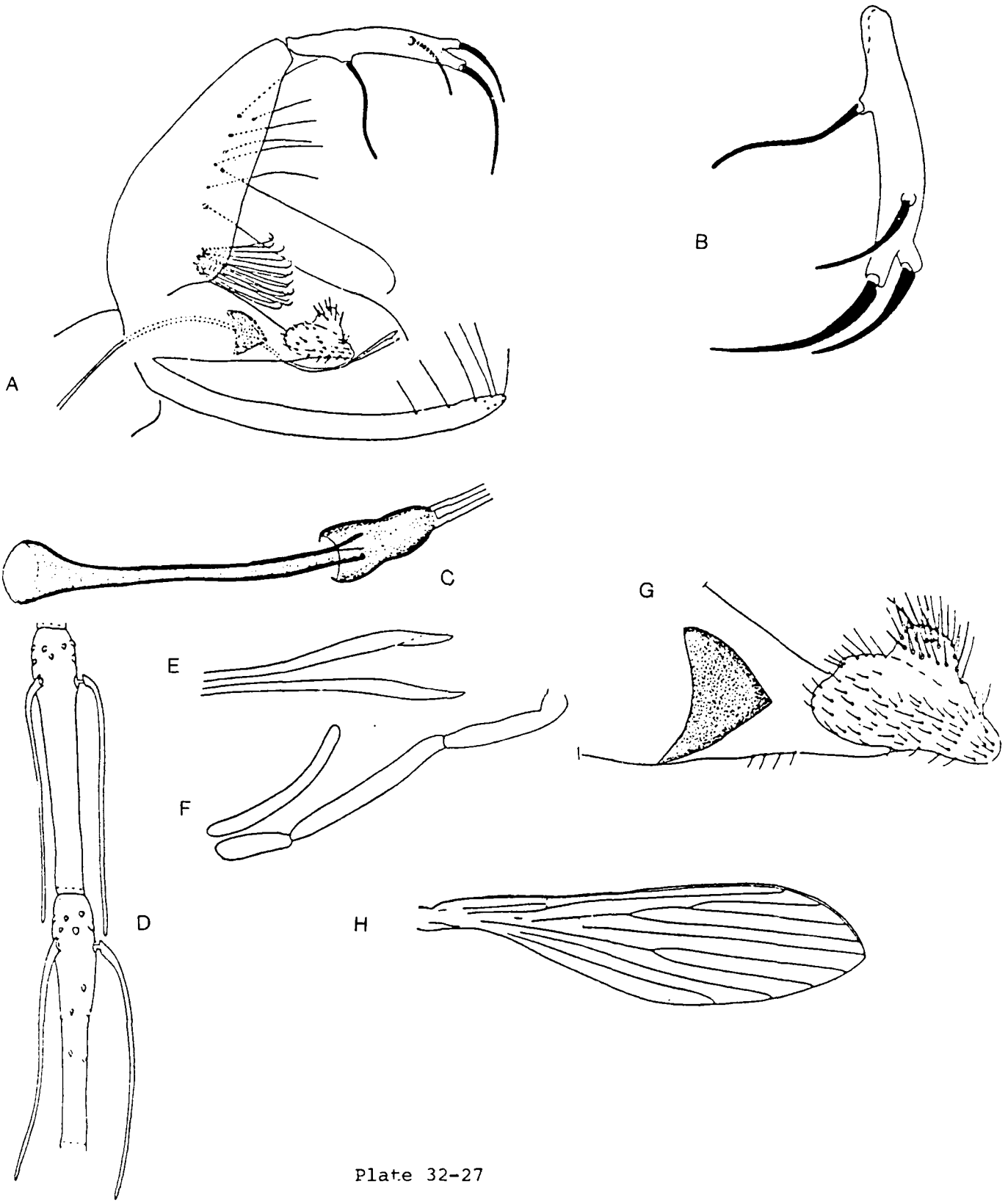



Plate 32-27

Lutzomyia incasica. A. Male terminalia; B. Style; C. Genital pump; D. Flagellomeres; E. Tips of genital filaments; F. Palpus; G. Paramere; H. Male wing (all figs. from Llanos 1964).

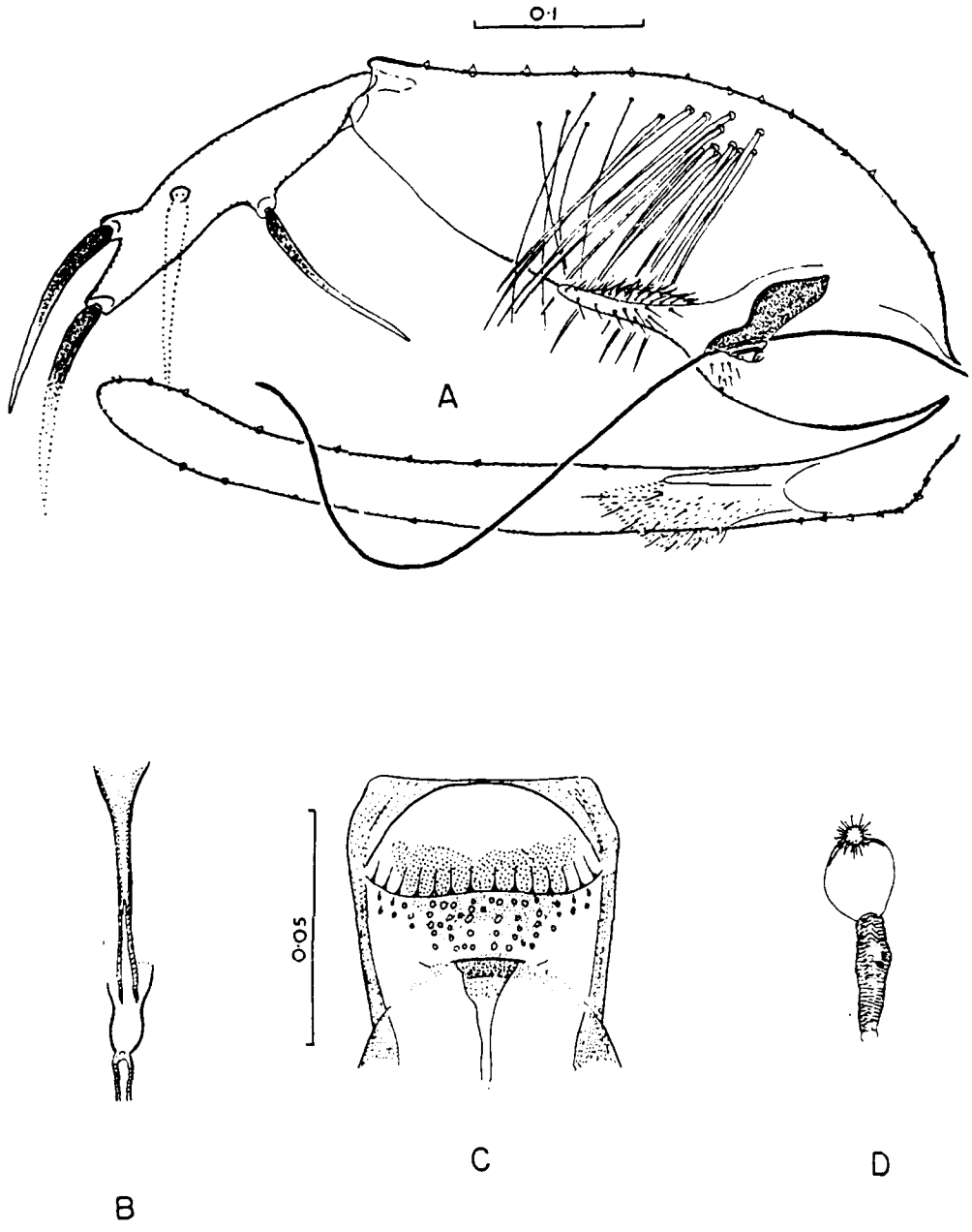



Plate 32-28

Lutzomyia rostrans. A. Male terminalia; B. Genital pump; C. Female cibarium; D. Spermatheca (all figs. from Lewis 1967a).

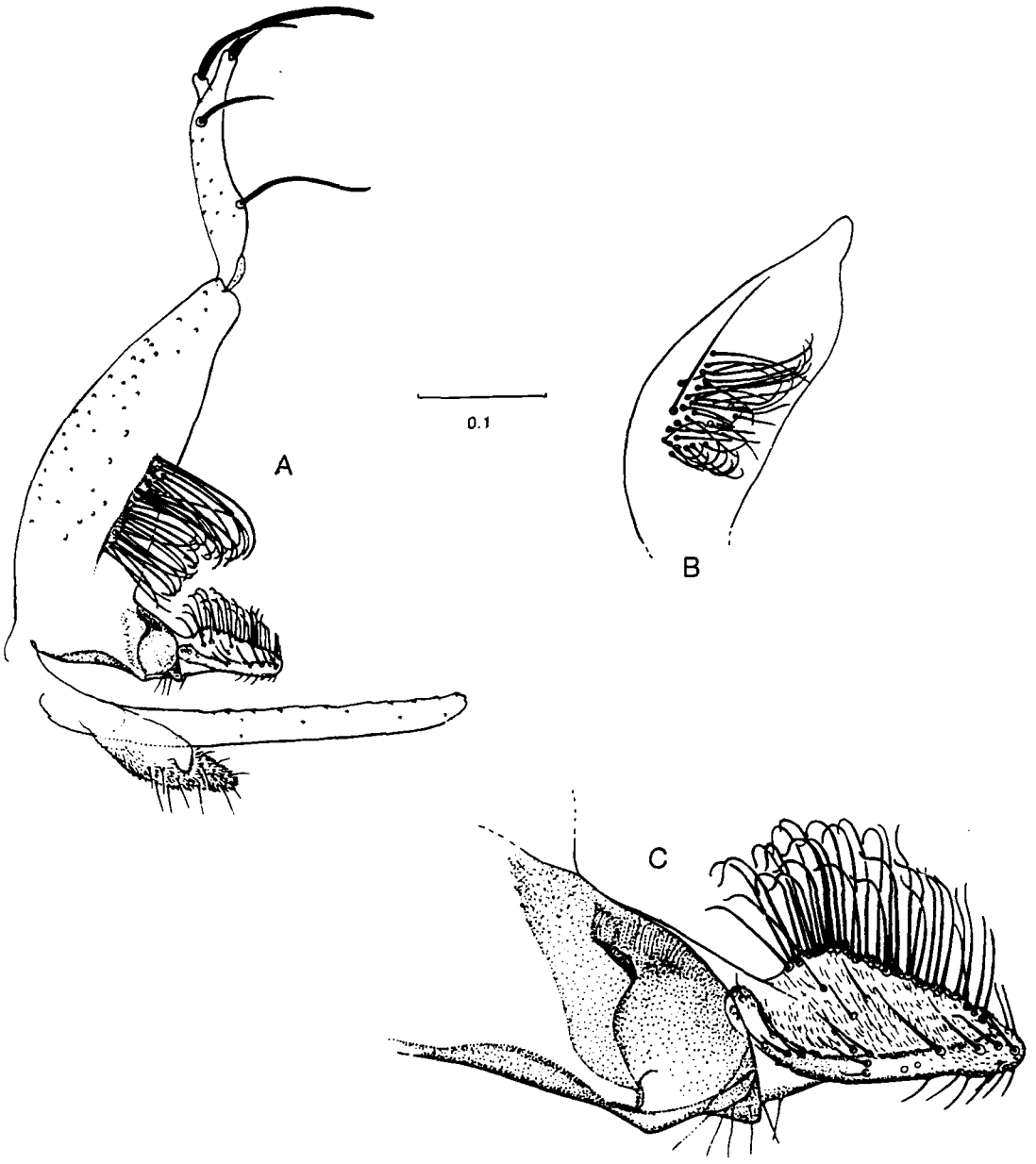



Plate 32-29

Lutzomyia loretonensis. A. Male terminalia; B. Coxite; C. Paramere.

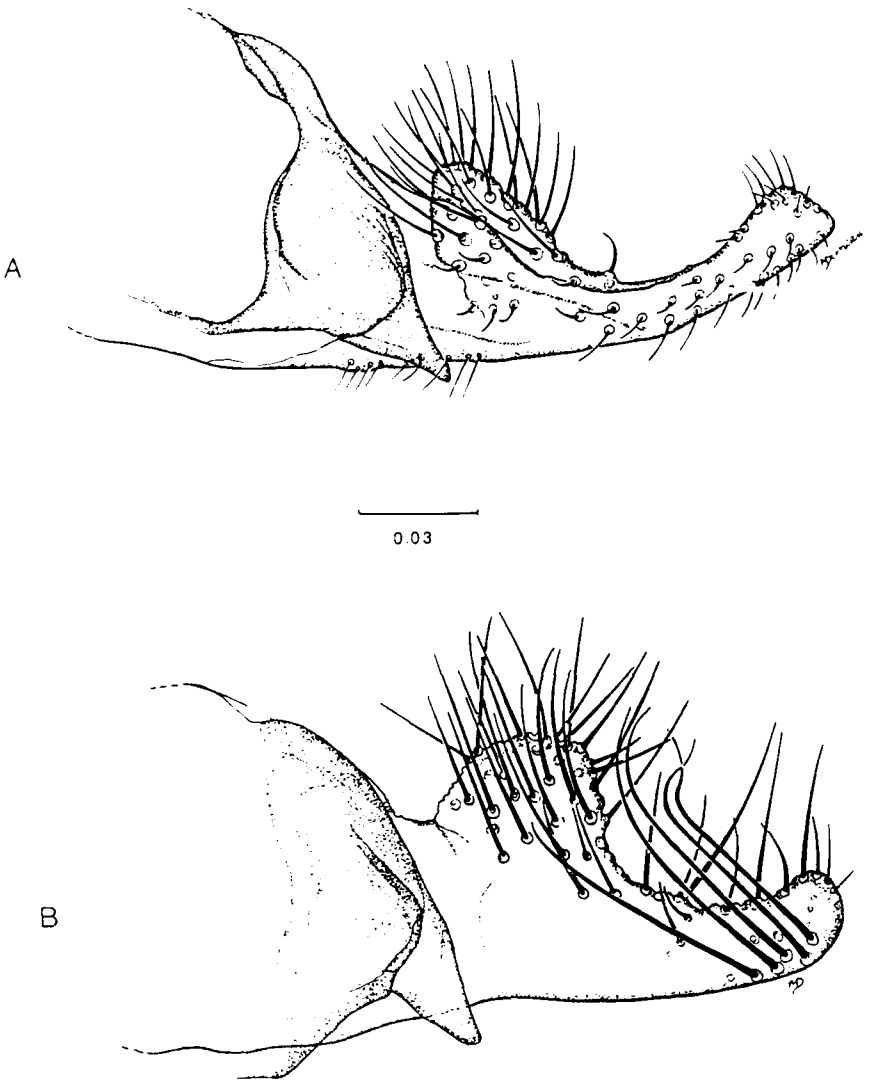



Plate 32-30

Lutzomyia howardi. A. Paramere.

Lutzomyia sp. 1 of Araracuara. B. Paramere.

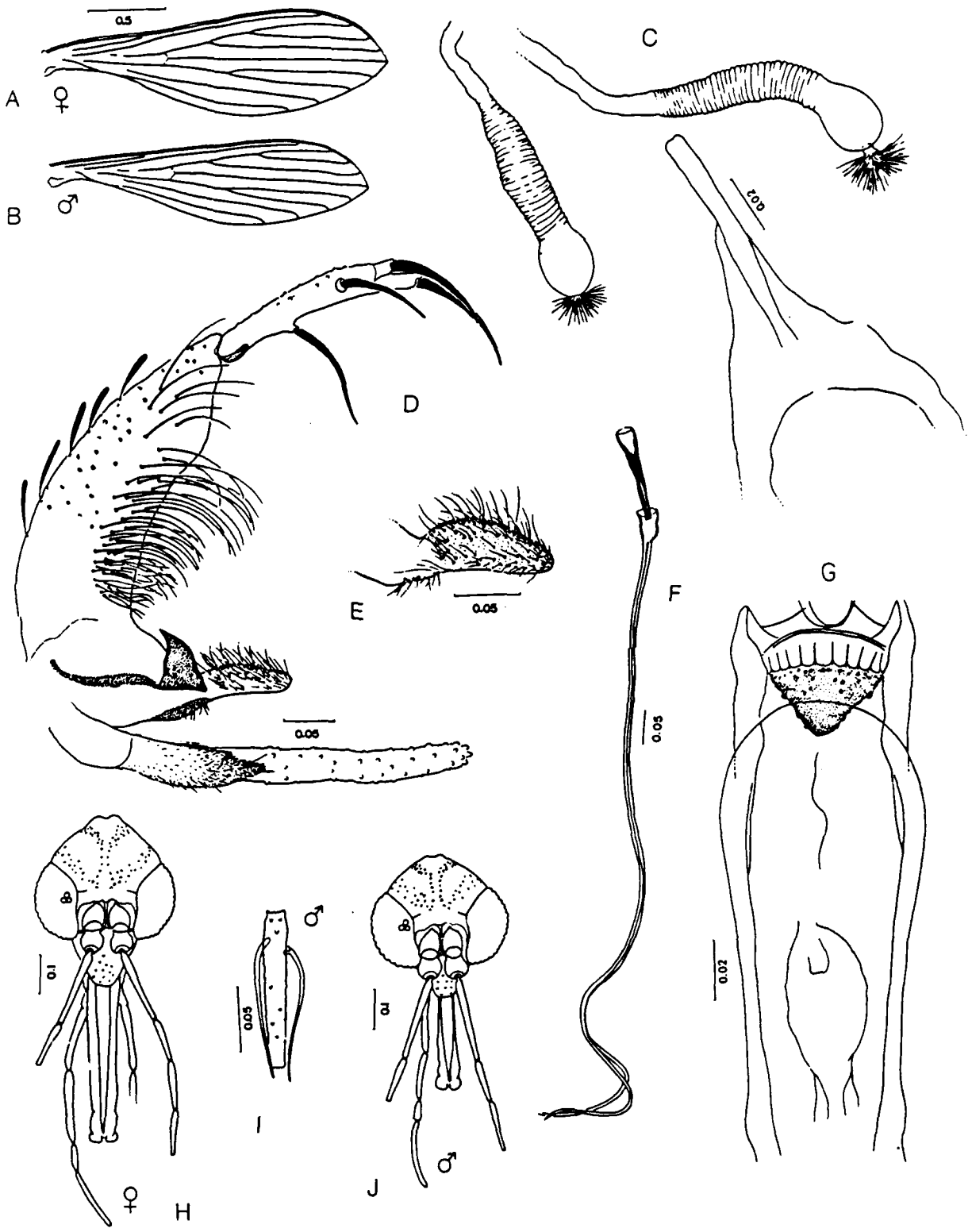
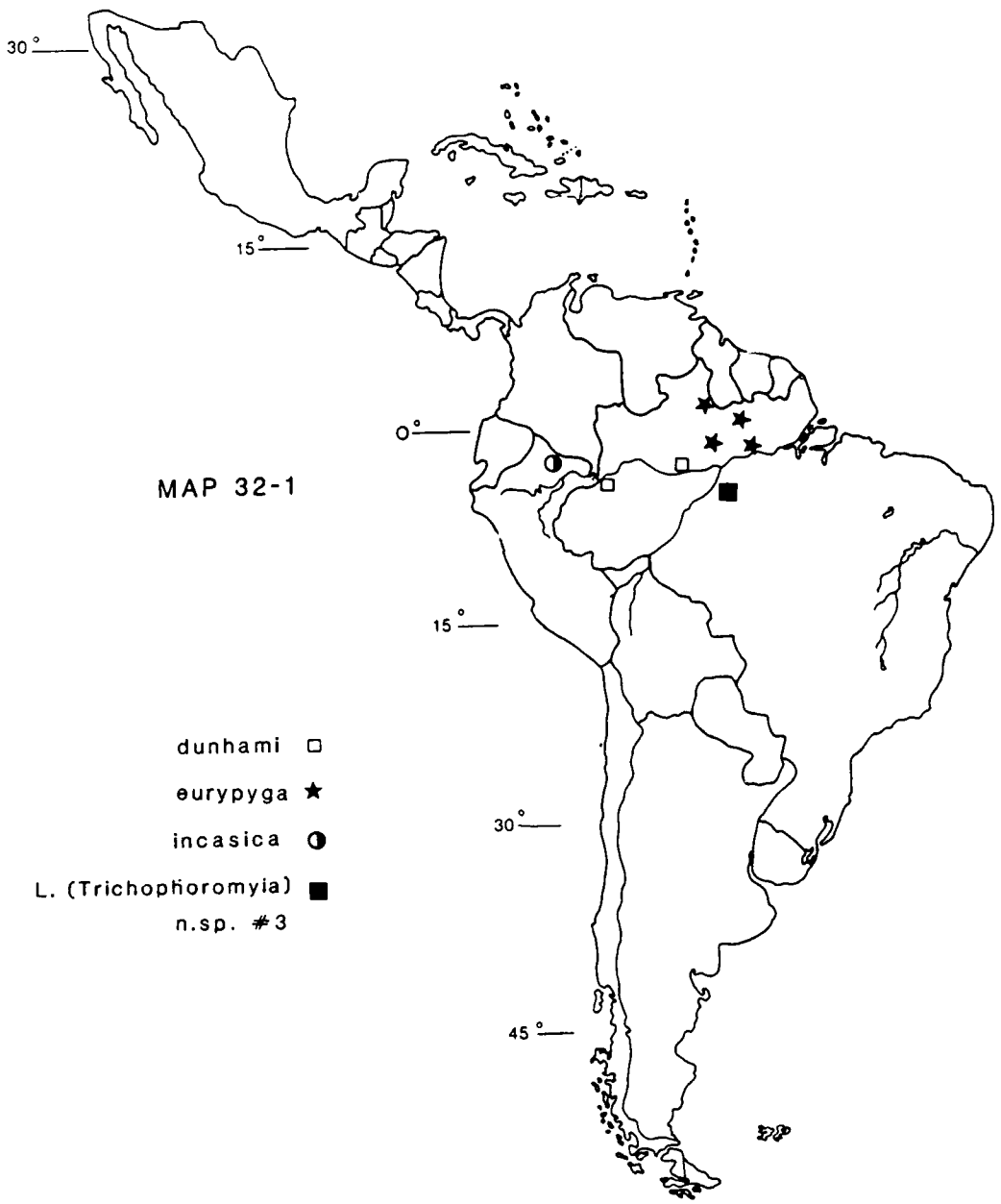
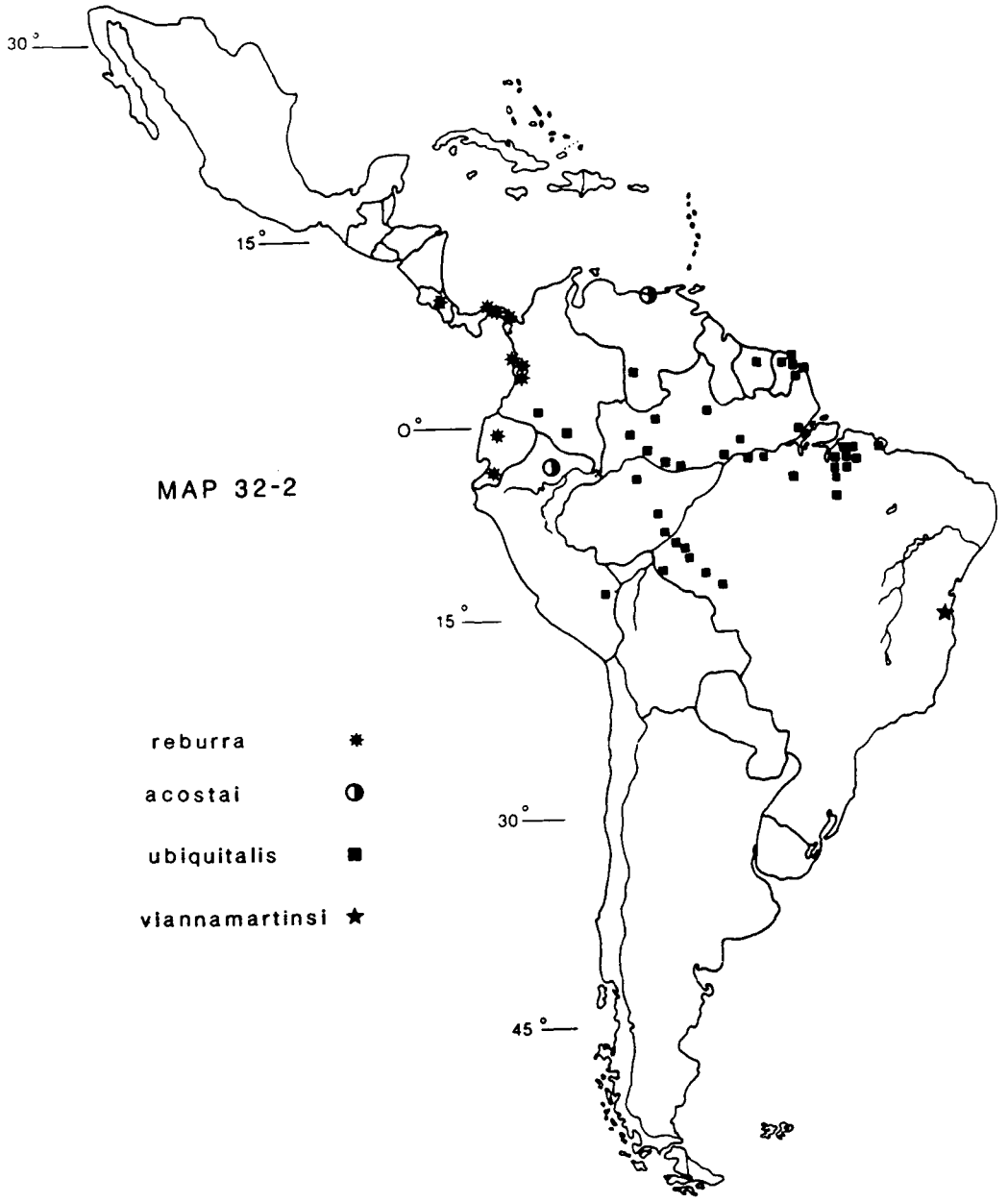



Plate 32-31

Lutzomyia ruii. A. Female wing; B. Male wing; C. Spermathecae; D. Male terminalia; E. Paramere; F. Genital pump & filaments; G. Female cibarium; H. Female head; I. Male flagellomere II; J. Male head (figs. from Arias & Young 1982).

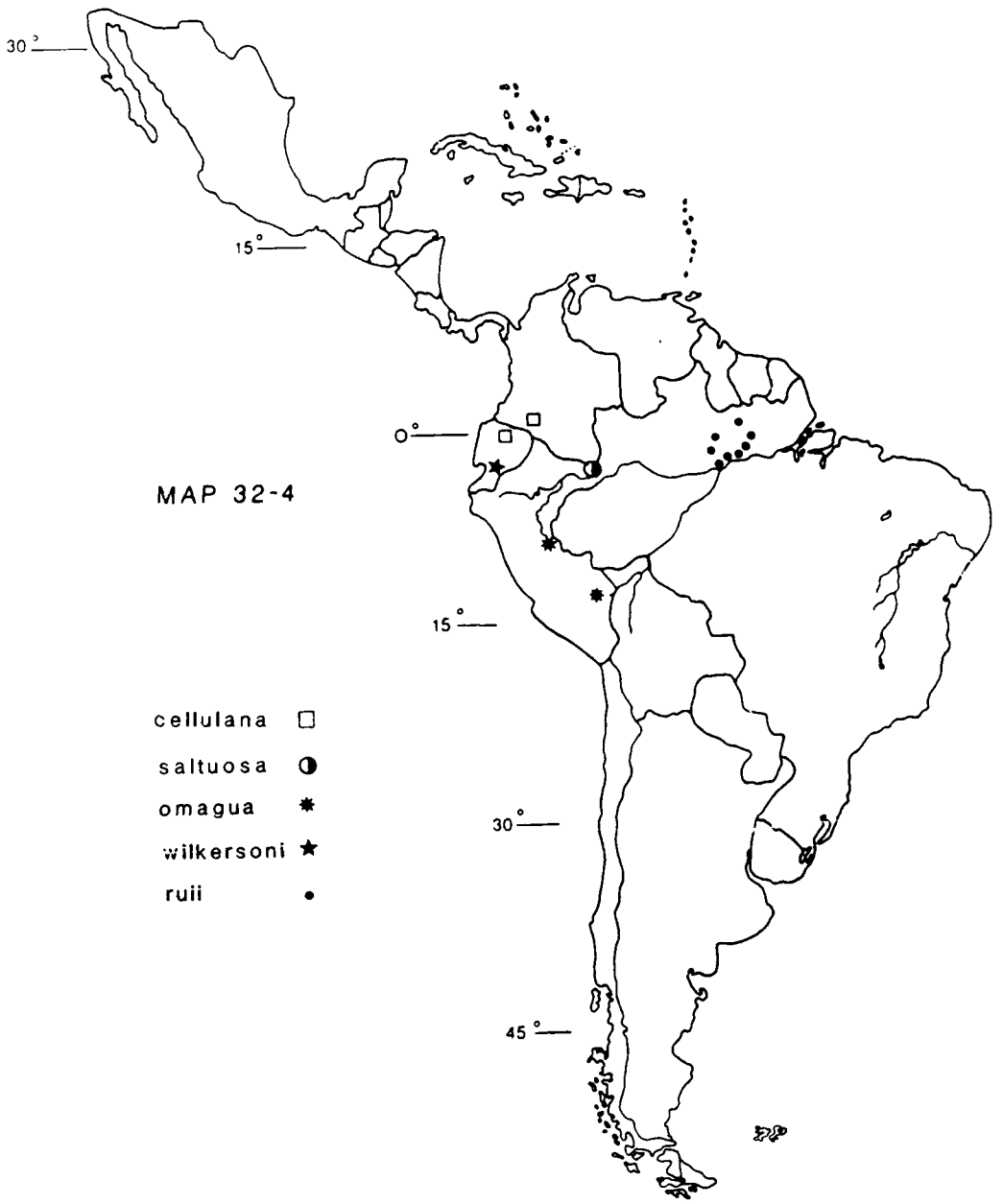

30°
15°
0°
15°
30°
45°
MAP 32-1
dunhami
eurypyga
incasica
L. (Trichophoromyia) n.sp. #3


30°
15°
0°
15°
30°
45°
reburra
acostai
ubiquitalis
viannamartinsi

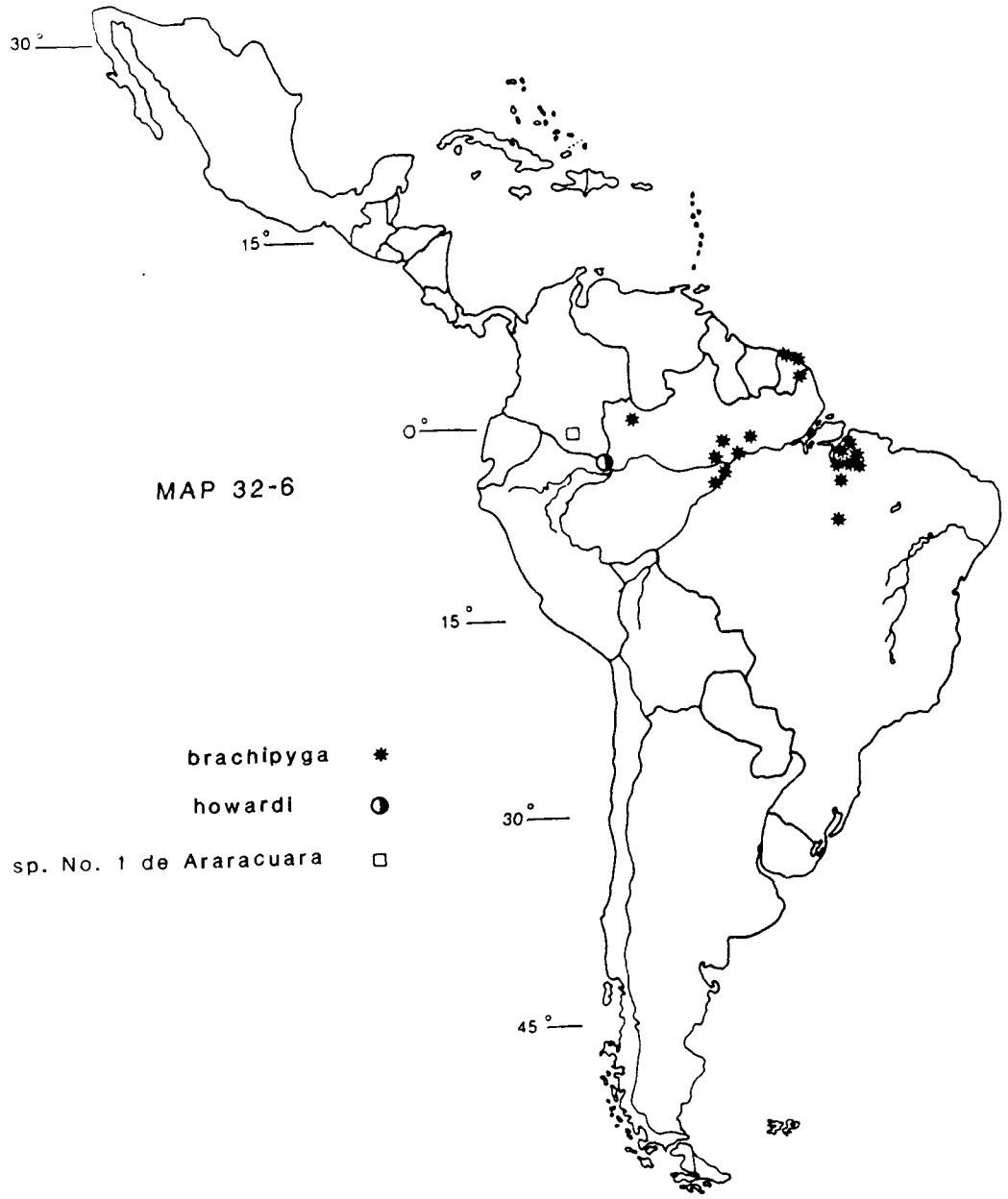
MAP 32-2

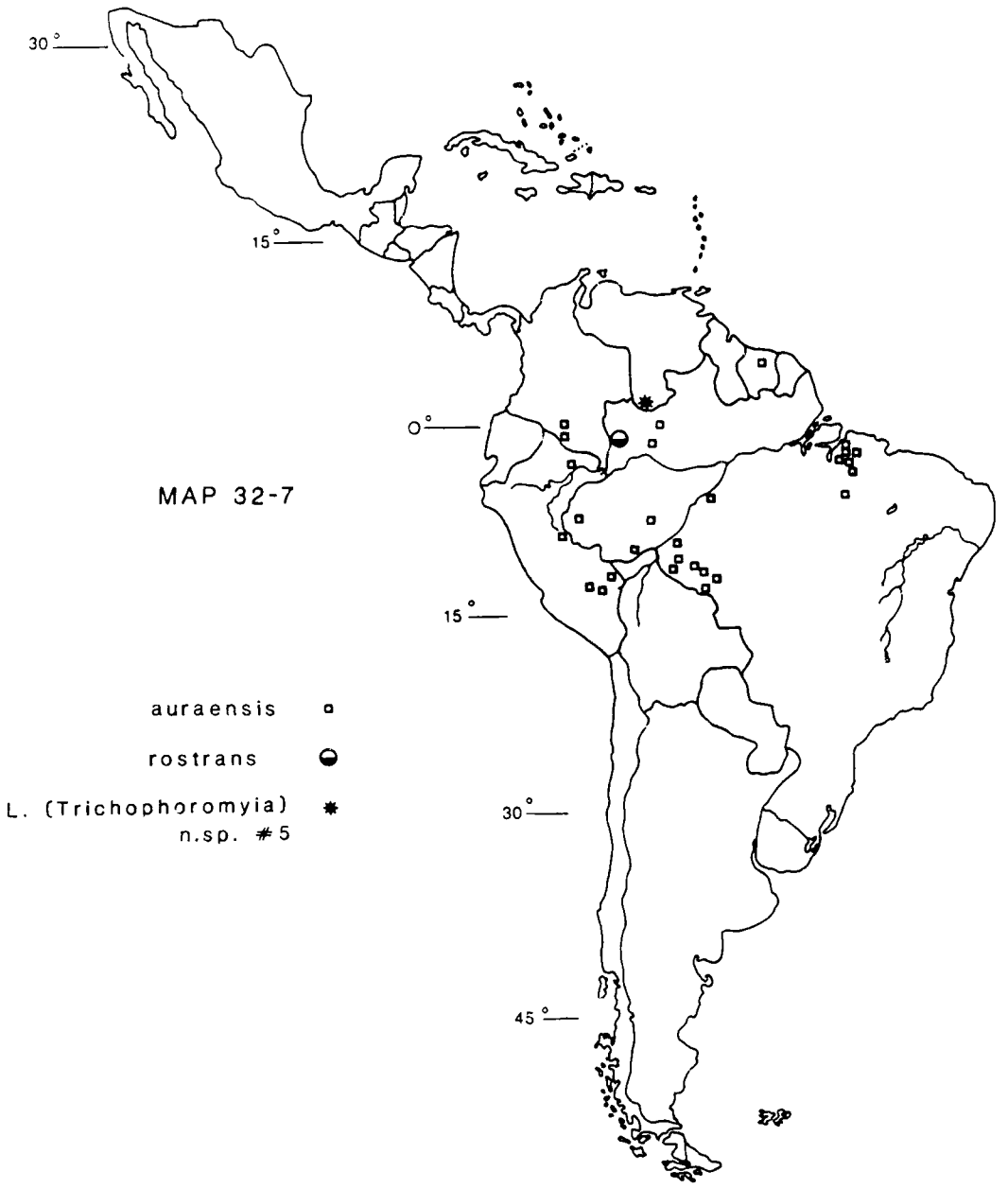



MAP 32-3

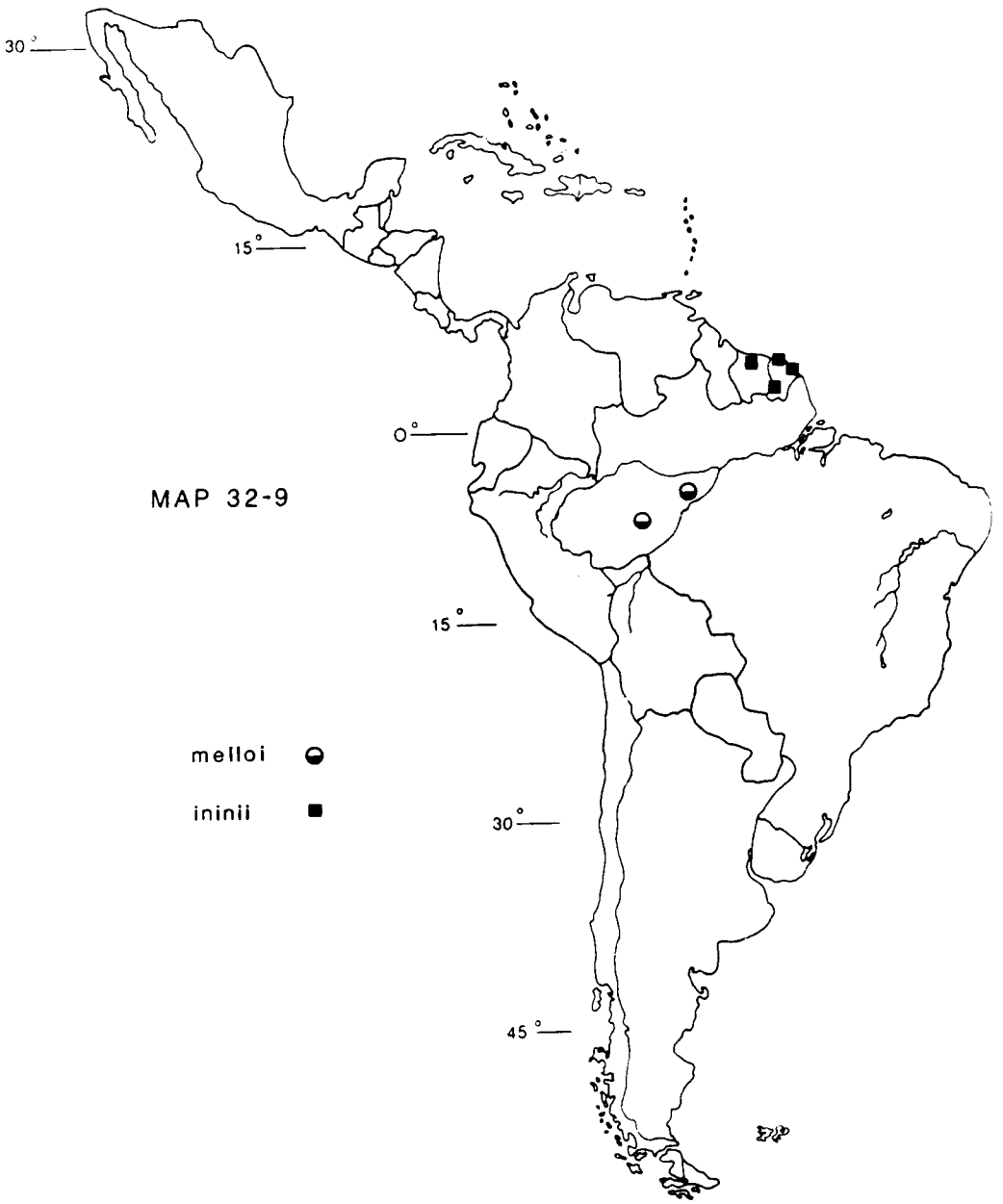

30°
15°
0°
15°
30°
45°
MAP 32-4
cellulana
saltuosa
omagua
wilkersoni
ruii

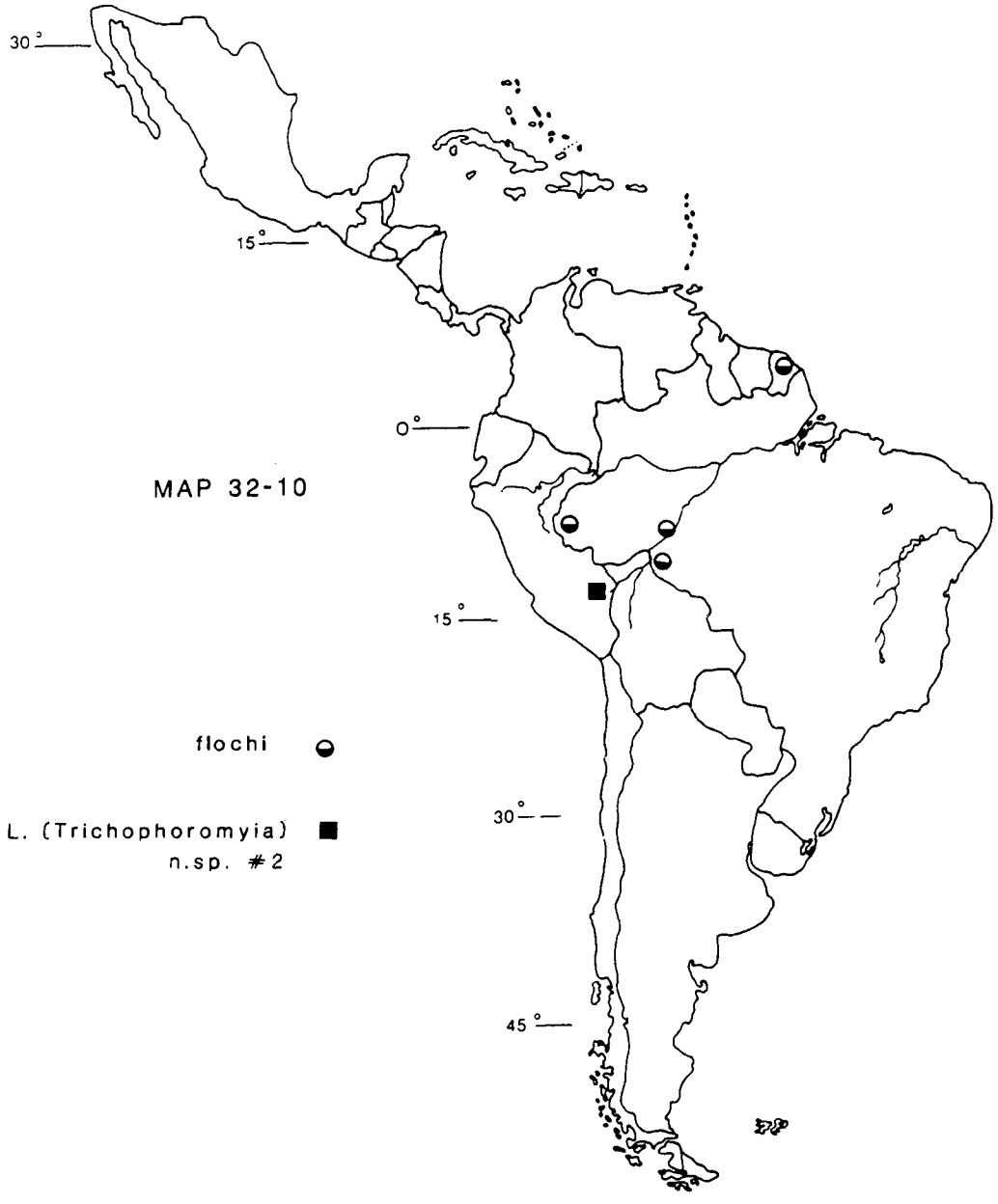

30°
15°
0°
15°
30°
45°
MAP 32-5
readyi
L. (Trichophoromyia) n.sp. #4
L. (Trichophoromyia) n.sp. #1


30°
15°
0°
15°
30°
45°
MAP 32-6
brachipyga
howardi
sp. No. 1 de Araracuara


30°
15°
0°
15°
30°
45°
MAP 32-7
auraensis
rostrans
L. (Trichophoromyia) n.sp. #5


30°
15°
0°
15°
30°
45°
MAP 32-8
castanheirai
napoensis
loretonensis


30°
15°
0°
15°
30°
45°
MAP 32-9
melloi
ininii


30°
15°
0°
15°
30°
45°
MAP 32-10
flochi
L. (Trichophoromyia) n.sp. #2


30°
15°
0°
15°
30°
45°
MAP 32-11
octavioi
L. (Trichophoromyia) n.sp. #6
beniensis

## 33. Lutzomyia Subgenus Psychodopygus Mangabeira

Phlebotomus subgenus Shannonomyia (not Shannonomyia Alexander) Dyar 1929: 117 (type species: Phlebotomus panamensis Shannon by orig. designation).

Flebotomus subgenus Psychodopygus Mangabeira 1941a: 237 (type species: Flebotomus unisetosus Mangabeira by orig. designation).

Phlebotomus subgenus Shannonomyina Pratt 1947: 86 (new name for Shannonomyia Dyar, not Shannonomyia Alexander). Fairchild & Hertig 1951a: 399 (review). Fairchild 1955: 188 (defined).

Lutzomyia subgenus Psychodopygus: Barretto 1962: 93 (defined). Theodor 965: 188 (defined). Barretto 1966: 133 (spp. keyed). Lewis et al. 1977: 328. Martins et al. 1978: 34 (defined).

Psychodopygus genus & subgenus: Forattini 1971a: 104; 1973: 392 (defined).

Phlebotomus subgenus Psychodopygus: Ortiz 1972b: 221 (spp. keyed, figs.).

Psychodopygus genus: Ready et al. 1980: 75 (defined, tax.).

Identification. Coloration variable, completely pale to dark. Antennal ascoids simple. Palpomere 5 very short, less than length of palp. 3. Eyes large. ♀ cibarium with 4-8 horizontal teeth, few to many vertical teeth; complete or incomplete arch. Pharynx unarmed. Spermathecae imbricated, i.e., with semi-telescoped annulations; individual and at

least part of common sperm ducts usually rugose or striated. ♂ genitalia. Coxite without persistent setae. Style with 1-6 large spines; smaller spines or setae present or not. Paramere simple to highly modified. Lateral lobe without specialized setae.

The Psychodopygus species are usually grouped into 3 or more informally named series or complexes based on male, and sometimes female, character states. (Theodor 1965, Ortiz 1972b, Martins et al. 1987, Young 1979, Ryan 1986). Reasons for elevating this subgenus to the generic level are given by Ready et al. (1980), but we continue to follow Lewis et al. (1977) who treat Psychodopygus as a subgenus of Lutzomyia. Accordingly, the status of Psychodopygus as a genus would necessitate elevating equally distinctive groups (subgenera) of Phlebotominae to this level, thereby considerably increasing the number of genera in both the Old and New Worlds.

Medical Importance. Considerable; females of most, if not all, species are anthropophilic and an increasing number are becoming incriminated as proven vectors of leishmaniasis to man (see Ryan et al. 1987c).

Key to the Males of the Subgenus Psychodopygus*

1. Style with 1 terminal spine & 3 subapical smaller setae. Paramere with a subtransverse row of setae, directed upwards, near middle of structure at level of aedeagus. Coxite bilobed or not (squamiventris complex) ..... 2

*The males of L. guyanensis and Lutzomyia sp. of Tres Esquinas are unknown.

Style with 1-6 large spines; subapical setae, if present, larger & spine-like. Paramere without such a row of setae. Coxite never bilobed ..... 11

2. Paramere with subterminal dorsal arm arising from ventral lateral side of structure ..... 3
Paramere without subterminal arm but small terminal projection may be present ..... 7

3. Paramere with 10+ long wavy setae at base of dorsal arm .....
..... L. bernalei (Pl. 33-1)
Paramere without such setae ..... 4

4. Whole insect pale. Style arched downwards. Coxite not bilobed or with median constriction. Paramere as shown .... L. lainsoni (Pl. 33-2)
Scutum dark. Style not distinctly arched. Coxite bilobed. Paramere otherwise ..... 5

5. Paramere with main lobe bulbous at end, without a subterminal notch on ventral margin ..... L. fairtigi (Pl. 33-3)
Paramere with main lobe otherwise & with subterminal notch on ventral margin ..... 6

6. Paramere with dorsal arm broadly subtriangular at end .....
..... L. wellcomei (Pl. 33-4)
Paramere with dorsal arm slightly clubbed & truncated at end .....
..... L. complexa (Pl. 33-5)

7. Paramere with dorsal group of 20+ long straight setae at distal fourth of structure ..... L. chagasi (Pl. 33-6)
Paramere without such a group of setae ..... 8

8. Paramere turned downwards distally, ventral margin concave ..... 9
Paramere turned upwards distally, ventral margin not concave ..... 10

9. Paramere with subterminal tooth-like projection on dorsal margin, without dorsal group of numerous setae .... L. leonidasdeanei (Pl. 33-7)
Paramere without subterminal tooth-like projection on dorsal margin; with dorsal group of numerous setae at and near middle of structure ..... Lutzomyia (Psychodopygus) n.sp. #1 (Pl. 33-8)

10. Paramere apex smoothly convex along ventral margin; dorsal seta smaller & more angular. Pronotum deeply pigmented .....
..... L. squamiventris squamiventris (Pl. 33-9)
Paramere apex with acute ventral keel & enlarged, rounded dorsal seta. Pronotum nearly pale .... L. squamiventris maripaensis (Pl. 33-9)

11. Paramere simple without ventral, lateral or dorsal arms ..... 12
Paramere with ventral, lateral or dorsal arms ..... 19

12. Style with 2 terminal spines & no other persistent setae or spines..
..... L. bispinosa (Pl. 33-10)
Style with 1-2 terminal spines and 2 or more other persistent setae or spines ..... 13

13. Style with 1 large terminal spine & 3 much shorter subapical setae or spines (guyanensis complex) ..... 14

Style with 1-2 large terminal spines and 2 other well developed spines (arthuri complex, in part) ..... 16

14. Paramere gently arched upwards, apex slightly enlarged .....
..... L. corossoniensis (Pl. 33-11 & 33-12)

Paramere sharply upturned; apex not enlarged ..... 15

15. Scutum dark. Paramere with distal upturned portion sinuous or curved, in part; end of paramere rounded ..... L. geniculata (Pl. 33-12)

Scutum pale. Paramere shorter with distal upturned portion more or less straight; end of paramere subacute .... L. dorlinsis (Pl. 33-12)

16. Paramere with dorsal basal group of 10 or more long setae .....
..... L. matosi (Pl. 33-13)

Paramere without a distinct dorsal group of long setae ..... 17

17. Style with all spines inserted at distal third of structure. Pronotum dark; coxa 1 & katepisternum pale ..... L. arthuri (Pl. 33-4)

Style with proximal spine inserted before or at middle of structure. Pronotum pale; coxa 1 & katepisternum pigmented .. L. lloydi (Pl. 33-15)

18. Style with 5 spines (davisi complex) ..... 19

Style with 3-4 spines ..... 21

19. Genital filaments longer than 5X genital pump length. Scutum dark; abdominal tergites 1-3 pale or but faintly pigmented ..... ..... L. davisi (Pl. 33-16)

Genital filaments shorter than 4.5X genital pump length. Abdominal tergites 1-3 as dark or nearly as dark as scutum ..... 20

20. Paramere with stout lateral arm, its length shorter than 3X its maximum width ..... L. claustrei (Pl. 33-17)

Paramere with more slender lateral arm, its length at least 5X its maximum width ..... L. amazonensis (Pl. 33-18)

21. Paramere with arched dorsal arm in addition to main lobe & ventral arm or lobe bearing setae ..... 22

Paramere without arched dorsal arm (panamensis complex) ..... 23

22. All coxae as dark as scutum. Paramere with dorsal arm bearing 4-5 long apical setae; main lobe clubbed at end & bearing small simple setae; ventral lobe with about 7 long straight setae ..... ..... L. llanosmartinsi (Pl. 33-19)

Coxae paler than scutum. Paramere with dorsal arm bearing 1 terminal small setae & 3 others inserted at different levels; main lobe nonclubbed & bearing 10 or more strong setae with recurved tips; ventral arm slender & bearing 2 strong setae at end ..... L. recurva (Pl. 33-20)

23. Paramere with main lobe bearing two tufts of blade-like setae; ventral arm with 2 large setae, one apical & one subapical ..... ..... L. panamensis (Pl. 33-21)
Paramere with main lobe bearing one tuft of setae, blade-like or not; ventral arm with smaller more numerous setae ..... 24

24. Paramere with main lobe bearing blade-like setae; ventral arm not situated below main lobe ..... 25
Paramere with main lobe bearing more slender setae; ventral arm lower than main lobe ..... 26

25. Procoxae infuscated. Paramere with a long dorsal basal seta isolated from others & borne on a distinct tubercle ..... ..... L. hirsuta nicaraguensis (Pl. 33-22)
Procoxae pale. Paramere without such a long seta ..... ..... L. hirsuta hirsuta (Pl. 33-22)

26. Coxa 1 & katepisternum strongly pigmented, as dark as scutum ..... 27
Coxa 1 & katepisternum pale ..... 28

27. Coxa 1-3 infuscated. Paramere larger, with most setae of main lobe clearly longer than width of lateral lobe ..... L. paraensis (Pl. 33-23)
Coxa 1 infuscated, coxae 2 & 3 pale. Paramere smaller with no setae of the main lobe longer than width of lateral lobe ..... ..... L. ayrozai (Pl. 33-24)

28. Whole insect, including scutum, pale ..... 29

Scutum pigmented in part or whole ..... 30

29. Genital filament tips simple. Lateral lobe longer than coxite ...

..... L. carrerai carrerai (Pl. 33-25)

L. carrerai thula (Pl. 33-26)

Genital filament tips modified as shown. Lateral lobe subequal to coxite in length ..... L. fairchildi (Pl. 33-27)

30. Paramere with reduced main lobe; its width subequal to width of lateral lobe ..... L. nocticola (Pl. 33-28)

Paramere larger, its width greater than 2X width of lateral lobe ..... L. yucumensis (Pl. 33-25)

## Key to the Females of the Subgenus Psychodopygus*

1. Whole insect pale ..... 2

Scutum pigmented in part or whole; other structures of insect may or may not be pigmented ..... 5

2. Cibarium with transverse row of subequal vertical teeth. Individual sperm ducts nearly as long as spermatheca ..... L. lainsoni (Pl. 33-2)

Cibarium with 3 or more irregular rows of vertical teeth; median teeth larger than others. Individual sperm ducts clearly shorter than spermathecae ..... 3

*The female of L. dorlinsis has not been described but is probably structurally similar to those of L. guyanensis, L. corossoniensis and L. geniculata

3. Cibarium with horizontal teeth slanted inwardly .....
..... L. fairchildi (Pl. 33-27)

Cibarium with horizontal teeth directed towards pharynx, not slanted inwardly ..... 4

4. Labrum <0.30 mm or shorter than combined length of scape & flagellomere I ..... L. carrerai carrerai (Pl. 33-25)
Labrum >0.30 mm or longer than combined length of scape & flagellomere I ..... L. carrerai thula (Pl. 33-26)

5. Cibarium with 6-8 horizontal teeth ..... 6
Cibarium with 4 horizontal teeth ..... 7

6. Coxa I & katepisternum moderately pigmented; pronotum pale. Common sperm duct convoluted, in part ..... L. lloydi (Pl. 33-15)
Coxa I & katepisternum pale; pronotum heavily pigmented. Common sperm duct not convoluted ..... L. arthuri (Pl. 33-14)

7. Spermathecae shorter than, or subequal in length, to individual duct ..... 8
Spermathecae clearly longer than individual duct ..... 14

8. Common sperm duct smooth-walled, without rugosity; individual ducts, in part, with "herringbone" pattern of rugosity .....
..... L. chagasi (Pl. 33-6)
L. complexa (Pl. 33-5)

L. fairtigi (Pl. 33-3)

L. squamiventris maripaensis (Pl. 33-9)

L. squamiventris squamiventris

L. (Psychodopygus) n.sp. #1 (Pl. 33-8)

Common sperm duct rugose in part and/or with transverse striations; individual ducts without "herringbone" pattern of rugosity ..... 9

9. Coxa I & katepisternum well pigmented, nearly as dark as scutum .... ..... L. matosi (Pl. 33-13)

Coxa I with or without faint pigmentation; if present, then paler than scutum; katepisternum always pale ..... 10

10. Common sperm duct with complete transverse striations over most or all of structure ..... 11

Common sperm duct smooth walled below rugose portion or with incomplete transverse striations; if complete striations are present, they do not extend beyond middle of structure ..... 12

11. Individual sperm duct with median band of numerous ( >75) small suboval excressences ..... L. leonidasdeanei (Pl. 33-7)

Individual sperm ducts rogose but lacking such excressences. ..... L. corossonensis (Pl. 33-11)

L. geniculata

L. guyanensis

? L. dorlinsis

12. Individual sperm ducts longer than 2X length of spermatheca. Cibarium with median longitudinal rows of markedly enlarged teeth... 13

Individual sperm ducts and spermatheca subequal in length. Cibarium without median row of enlarged teeth; with only 1-2 transverse rows of vertical teeth ..... L. recurva (Pl. 33-20)

13. Individual sperm duct about half as long as common duct ..... ..... L. sp. of Tres Esquinas (Pl. 33-12)

Individual sperm duct longer than common duct ..... ..... L. bernalei (Pl. 33-1)

14. Katepimeron nearly as dark as scutum ..... 15

Katepimeron pale ..... 17

15. Cibarium with elevated mound between inner pair of horizontal teeth bearing 10+ subequal vertical teeth ..... L. paraensis (Pl. 33-23)

Cibarium without such a structure ..... 16

16. Cibarium with inwardly slanted horizontal teeth. Coxa 1 well pigmented; coxae 2 & 3 pale or with faint pigmentation. Labrum 0.40 mm ..... L. ayrozai (Pl. 33-24)

Cibarium with horizontal teeth directed towards pharynx, not inwardly slanted. All coxae well pigmented. Labrum <0.40 mm ..... ..... L. llanosmartinsi (Pl. 33-19)

17. Common sperm duct with distinct striations or dot-like thickenings below rugose portion ..... 18

Common sperm duct smooth walled below rugose portion ..... 21

18. Common sperm duct with complete or nearly complete transverse striations. Genital fork stem broad, blade-like ..... ..... *L. bispinosa* (Pl. 33-10)

Common sperm duct with dot-like thickenings below rugose portion. Genital fork stem more slender, subacute at tip ..... 19

19. Individual sperm duct shorter than half the length of the spermathecae; rugose portion of common duct swollen near junction of individual ducts ..... 20

Individual sperm duct larger than half the length of the spermathecae; rugose portion of common duct more or less subequal in width, not swollen ..... *L. davisi* (Pl. 33-16)

20. Coxa 1 moderately pigmented ..... *L. hirsuta nicaraguensis* (Pl. 33-22)

Coxa 1 pale ..... *L. hirsuta hirsuta* (Pl. 33-22)

21. Pronotum well pigmented ..... *L. claustrei* (Pl. 33-17)
? *L. parimaensis*

Pronotum pale ..... 22

22. Cibarium with 1 transverse row of vertical teeth ..... ..... *L. amazonensis* (Pl. 33-18)

Cibarium with transverse row of vertical teeth plus longitudinal median rows of markedly enlarged vertical teeth ..... 23

23. Spermathecae with asymmetrical terminal annulation .....
..... L. panamensis (Pl. 33-21)
Spermathecae with symmetrical terminal annulation ..... 24

24. Labrum <0.30 mm long. Scutum with similar degree of pigmentation at dorsum & at sides ..... L. yucumensis (Pl. 33-25)
Labrum >0.30 mm. long. Scutum pale dorsally; moderately pigmented at sides ..... L. nocticola (Pl. 33-28)

Lutzomyia (Psychodopygus) bernalei (Osorno, Morales & Osorno)

Plate 33-1

Phlebotomus bernalei Osorno, Morales & Osorno 1967: 30 (♂, Araracuara, Caqueta, Colombia).

Psychodopygus bernalei: Forattini 1973: 392 (♂ fig., tax.). Fraiha et al. 1987: 336 (♂ fig.).

Lutzomyia bernalei: Martins et al. 1978: 35. Young 1979: 170 (♂ fig.). Morales & Minter 1981: 105 (Caqueta, Colombia).

Distribution (Map 33-1). Colombia (Osorno et al. 1967; Morales & Minter 1981). Venezuela (♂♂, ♀♀, Cerro Neblina, Amazonas, D. Pinero). Brazil (♂♂, ♀♀, Br. 307, Km 10, Cachoeira, Amazonas, J. Arias).

Remarks. The male of L. bernalei is easily recognized by the dorsal group of long setae on the paramere at the base of the dorsal arm. The undescribed female, collected with males in Venezuela and Colombia, will be fully described by D. Feliciangeli in a forthcoming paper.

## Lutzomyia (Psychodopygus) lainsoni (Fraiha & Ward)

Plate 33-2

Psychodopygus lainsoni Fraiha & Ward 1974: 209 (♂, ♀, Transamazon Highway, Km 46. Altamira-Itaituba, Pará, Brazil). Ward & Ready 1975: 128 (egg structure). Ward 1976: 236 (larva). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ryan 1986: 126 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil). Fraiha et al. 1987: 338 (mention).

Lutzomyia lainsoni: Martins et al. 1978: 49 (refs., dist.). Young et al. 1985: 145 (Madre de Dios, Peru).

Distribution (Map 33-2). Brazil (Martins et al. 1978; Fraiha et al. 1978; Biancardi et al. 1982); Peru (Young et al. 1985).

Remarks. The male terminalia of L. lainsoni is extraordinarily modified and readily identifiable. Females are anthropophilic but, as yet, have not been found naturally infected with flagellates.

## Lutzomyia (Psychodopygus) fairtigi Martins

Plate 33-3

Lutzomyia fairtigi Martins 1970: 279 (♂, Villavicencio, Meta, Colombia). Martins et al. 1978: 36 (dist., refs.). Young 1979: 171 (♂, ♀ figs., refs.).

Phlebotomus squamiventris (not squamiventris Lutz & Neiva): Fairchild & Hertig 1951a: 414 (♂, ♀ figs., Colombia).

Psychodopygus fairtigi: Fraiha et al. 1971: 495 (cf. to wellcomei). Forattini 1973: 392 (figs., tax.). Fraiha et al. 1986: 336 (♂ fig., cf. to leonideanesi).

Phlebotomus fairtigi: Ortiz 1972b: 225 (figs., tax.).

Distribution (Map 33-2). Colombia (Fairchild & Hertig 1951a; Young 1979).

Remarks. Forattini (1971b) reported L. fairtigi from Mato Grosso, Brazil--a record considered dubious because only females were collected.

## Lutzomyia (Psychodopygus) wellcomei (Fraiha, Shaw & Lainson)

Plate 33-4

Psychodopygus wellcomei Fraiha, Shaw & Lainson 1971: 490 (♂, ♀, Serra dos Carajas, Pará, Brazil). Ward 1972: 15 (immatures). Ward et al. 1973: 178 (Pará Brazil). Ready et al. 1983: 235 (Ceará, Brazil). Wilkes et

al. 1984: 78 (parous rates & biting habits). Ready et al. 1984: 3 (cf. to complexa, allozyme analysis). Lane & Ready 1985: 469 (morphometrics). Ryan et al. 1986: 43 (cuticular hydrocarbon analysis). Killick-Kendrick 1986: 135 (listed). Ryan 1986: 141 (♂, ♀ figs., Pará, Brazil). Fraiha et al. 1987: 336 (♂, ♀ figs., cf. to leonideanesi). Ryan et al. 1987a: 356 (in part, nat. Leishmania infections, Brazil).

Lutzomyia wellcomei: Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 38 (refs., dist.). Young & Lawyer 1987: 45 (Amazonas, Brazil, & refs. to role as vector of Leishmania braziliensis).

Distribution (Map 33-3). Brazil (Ryan 1986; Young & Lawyer 1987).

Remarks. Lutzomyia wellcomei is a proven vector of Leishmania braziliensis at the type locality in Pará, Brazil (Lainson & Shaw 1979). This species may have been misidentified as L. squamiventris (Lutz & Neiva) by Lucena (1953) in Ceará, Brazil (see Ready et al. 1983). Both sexes were captured near the Rio Urubu, Amazonas, Brazil, by J. Arias and D. Young in lowland forest (Young & Lawyer 1987), but it is not known to be a Leishmania vector there.

## Lutzomyia (Psychodopygus) complexa (Mangabeira)

Plate 33-5

Flebotomus complexus Mangabeira 1941a: 242 (♂, Abaete, Pará, Brazil).

Lutzomyia complexa: Theodor 1965: 188 (listed). Martins et al. 1978: 38 (as synonym of squamiventris).

Psychodopygus complexus: Forattini 1973: 407 (♂ fig., tax.). Ward & Ready 1975: 128 (egg). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready et al. 1982: 201 (as distinct species); 1984: 3 (cf. to wellcomei, alloenzyme analysis). Lane & Ready 1985: 469 (morphometrics). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan et al. 1986: 85 (cf. to wellcomei, cuticular hydrocarbons). Ryan 1986: 137 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (in part, dissecting data for flagellates). Fraiha et al. 1987: 336 (♂, ♀ figs., cf. to leonideanesi).

Distribution (Map 33-4). Brazil (Ready et al., 1982; Biancardi et al. 1982; Ryan 1986, Arias 1987, unpubl. data).

Remarks. The females of L. complexa and L. wellcomei are structurally similar and it is difficult to distinguish them by color or morphology. Other methods, such as cuticular hydrocarbon analysis, have been successfully used to separate females. The males of these species, on the other hand, are easily recognized by their characteristic terminalia.

## Lutzomyia (Psychodopygus) chagasi (Costa Lima)

Plate 33-6

Phlebotomus chagasi Costa Lima 1941: 6 (♀, Rio Negro, Amazonas, Brazil).

Flebotomus unisetosus Mangabeira 1941a: 238 (♂, Abaeté, Pará, Brazil). Martins et al. 1968: 1 (as synonym of chagasi).

Lutzomyia chagasi: Theodor 1965: 188 (♂ fig.). Llanos 1973: 31 (figs., Peru). Martins et al. 1978: 35 (refs., dist.). Young 1979: 170 (♂ fig., refs., Colombia). Morales & Minter 1981: 105 (Caqueta, Colombia). Young et al. 1985: 144 (Peru).

Psychodopygus chagasi: Forattini 1973: 392 (fig., tax.). Fraiha et al. 1974: 89 (♂ figs., biting man); 1978: 136 (Pará, Brazil). Fraiha et al. 1980b: 21 (Peru). Llanos 1981: 183 (Peru). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias et al. 1985: 1101 (neg. for flagellates, Brazil). Ryan 1986: 136 (♂, ♀ figs., Pará, Brazil). Fraiha et al. 1986: 336 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 33-5). Peru (Llanos 1973; 1981; Fraiha et al. 1980b; Young et al. 1985). Brazil (Martins et al. 1978; Fraiha et al. 1978: Biancardi et al. 1982; Ryan 1986); Colombia (Young 1979).

Remarks. The presence of L. chagasi at the Tambopata Reserve, Madre de Dios, Peru (Young et al. 1985) was confirmed after discovering males from there in 1986 (Young & Perez, unpubl. data).

Lutzomyia (Psychodopygus) leonidasdeanei

(Fraiha, Ryan, Ward, Lainson & Shaw)

Plate 33-7

Psychodopygus leonidasdeanei Fraiha, Ryan, Ward, Lainson & Shaw 1986: 333 (♂, ♀, Santarem, Pará, Brazil).

Psychodopygus sp. no. 401.63 Fraiha et al. 1978: 134 (dist., Pará, Brazil).

Ryan 1986: 138 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 33-6). Brazil (refs. given above).

Lutzomyia (Psychodopygus) n.sp. #1

Plate 33-8

Distribution (Map 33-6). Venezuela (♂♂, ♀♀, Cano Marieta, Amazonas, D. Feliciangeli).

Remarks. This species, clearly a member of the squamiventris series of Psychodopygus, will be fully described by D. Feliciangeli in 1988.

Lutzomyia (Psychodopygus) squamiventris squamiventris (Lutz & Neiva)

Plate 33-9

Phlebotomus squamiventris Lutz & Neiva 1912: 89 (♀, Rio Tambobeta, Pará, Brazil).

Lutzomyia squamiventris: Theodor 1965: 188 (listed).

Psychodopygus squamiventris: Martins et al. 1968: 9 (♀, redescript.).

Lutzomyia maripaensis (not maripaensis Floch & Abonnenc): Arias & Freitas 1977; 1978.

Psychodopygus squamiventris squamiventris: Ready et al. 1982: 201 (♂, ♀ figs., tax., dist.). Arias et al. 1985: 1101 (nat. flagellate infections, Brazil). Ready 1985: 30 (mention). Ryan 1986: 140 (♂, ♀ figs., Brazil). Fraiha et al. 1986: 336 (♂, ♀ figs., cf. to leonideanesi).

Distribution (Map 33-7). Brazil (Ready et al. 1982; Ryan 1986).

Remarks. The literature is replete with misidentifications of this species. Ready et al. (1982), after studying samples of various populations of L. squamiventris and related taxa, resolved many of these taxonomic problems. They noted that there are "no valid reports of L. squamiventris sensu stricto being found south of the river Amazon."

The presence of L. squamiventris (either subspecies) in Venezuela (see Feliciangeli 1980) can only be verified when males are obtained from there.

## Lutzomyia (Psychodopygus) squamiventris maripaensis

(Floch & Abonnenc)

Plate 33-9

Phlebotomus maripaensis Floch & Abonnenc 1946a: (♂, Oyapock, Maripa, French Guiana); 1952: 61 (♂ figs.). Forattini 1973: 398 (as synonym of squamiventris).

Lutzomyia maripaensis: Theodor 1965: 188 (listed). Martins et al. 1978: 36 (in part, refs., dist.). Leger et al. 1980: 116 (French Guiana). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus maripaensis: Lainson et al. 1979: 241 (neg. for flagellate infections, Brazil).

Psychodopygus squamiventris maripaensis: Ready et al. 1982: 201 (as subspecies, figs., tax. dist.); 1983: 780 (Para, Brazil). Ryan 1986: 139 (♂, ♀ figs., Pará, Brazil). Fraiha et al. 1986: 336 (♂ fig.).

Lutzomyia squamiventris maripaensis: Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 25 (Pará, Brazil).

Distribution (Map 33-7). French Guiana (Floch & Abonnenc 1952; Leger et al. 1980); Suriname (Hudson & Young 1985); Brazil (Ready et al. 1982; Ryan 1986).

Remarks. See Ready et al. (1982) for full references and taxonomic information of this subspecies.

## Lutzomyia (Psychodopygus) bispinosa (Fairchild & Hertig)

Plate 33-10

Phlebotomus bispinosus Fairchild & Hertig 1951a: 410 (♂, ♀, La Victoria, Cerro Jefe, Panama). Lewis & Garnham 1959: 80 (♀, Belize).

Lutzomyia bispinosa: Barretto 1962: 94 (listed). Arias & Freitas 1977: 511 (Amazonas, Brazil). Leger et al. 1977: 223 (French Guiana). Arias & Freitas 1978: 391 (negative for flagellates, Brazil). Martins et al. 1978: 46(refs., dist.). Young 1979: 173 (figs., refs.). Le Pont & Pajot 1980: 64 (cf. to claustrei). Morales & Minter 1981: 97 (Colombia). Lewis & Macfarlane 1981: 177 (mite parasite, Belize). Williams 1983: 489 (tax.). Young & Rogers 1984: 599 (listed, Ecuador). Ready et al. 1986: 26 (Pará, Brazil). Vexenat et al. 1986: 296 (Bahia, Brazil). Porter et al. 1987: 929 (Guatemala).

Psychodopygus bispinosus: Forattini 1973: 170 (figs., tax.). Lainson et al. 1976: 57 (Mato Grosso, Brazil); 1979: 241(negative for flagellates, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 121 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil).

Distribution (Map 33-8). Belize; Honduras; Nicaragua; Panama (Martins et al. 1978); Guatemala (Porter et al. 1987); Panama (Martins et al. 1978); Colombia (Young 1979; Morales & Minter 1981); Ecuador (Young 1979); Brazil (Lainson et al. 1976; Martins et al. 1978; Ryan 1986); French Guiana (Leger et al. 1977).

Remarks. This species was reported from Bahia State, Brazil by Vexenat et al. (1986b), but females examined by us from there have slender genital fork stems, unlike typical L. bispinosa females found in northern Brazil and elsewhere. We have not seen males from Bahia, Brazil, and therefore consider its presence there as doubtful pending additional material.

Lutzomyia (Psychodopygus) corossoniensis Le Pont & Pajot

Plates 33-12 & 33-13

Lutzomyia corossoniensis Le Pont & Pajot 1978: 224 (♂, near Corossony, French Guiana). Murillo & Zeledón 1985: 64 (♂ fig., Costa Rica). Lebbe et al. 1987: 29 (computer aided ident.).

Lutzomyia guyanensis, in part: Young 1979: 186 (♂ fig., Panama).

Psychodopygus corossoniensis: Le Pont & Desjeux 1982: 281 (♂, cf. to dorlinsis). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias et al. 1985: 1101 (negative for flagellate infections, Brazil). Ryan 1986: 123 (♂, ♀, Brazil). Fraiha et al. 1987: 338 (mention).

Distribution (Map 33-9). Costa Rica (Murillo Zeledón 1985); Panama (Young 1979, in part, ♂); French Guiana (Le Pont & Pajot 1978); Brazil (Biancardi et al. 1982; Arias et al. 1985; Ryan 1986; Arias 1987, unpubl. data) Suriname (Hudson & Young 1985).

Remarks. Lutzomyia corossoniensis, L. dorlinsis, L. geniculata and L. guyanensis form a species complex within Psychodopygus. The male of the latter species remains unknown, but it is probably conspecific with one of the other 3 species. Young (1979), following Forattini (1973), treated L. geniculata as a junor synonym of L. guyanensis, but the subsequent descriptions of the other species now indicate this synonym may not be correct. The male illustrated by Young (1979) represents L. corossoniensis, not L. geniculata.

Lutzomyia (Psychodopygus) geniculata (Mangabeira)

Plate 33-12

Flebotomus geniculatus Mangabeira 1941a: 245 (♂, Aurá, Belém, Pará, Brazil). Barretto 1947a: 202 (refs.).

Phlebotomus geniculatus: Fairchild & Hertig 1951a: 40 (♂, ♀ figs., Panama). Ortiz 1972b: 230 (keyed, figs.). Forattini 1959: 160 (Amapa, Brazil).

Lutzomyia geniculata: Barretto 1962: 94 (listed). Llanos et al. 1975b: 670 (Peru). Martins et al. 1978: 48 (refs., figs.). Young 1979: 186 (in part, refs.). Morales & Minter 1981: 97 (Colombia). Williams 1983: 489 (cf. to related spp.). Murillo & Zeledón 1985: 64 (♂, ♀ figs., Costa Rica).

Lutzomyia guyanensis (= geniculatus Mangabeira): Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 64 (♂, figs., Costa Rica). Young et al. 1985: 144 (Peru).

Psychodopygus geniculatus: Forattini 1973: 124 (as synonym of guyanensis, figs., tax.). Le Pont & Desjeux 1982: 282 (♂ fig., cf. to dorlinsis). Ryan 1986: 125 (♂, ♀ figs., Pará, Brazil).

Psychodopygus guyanensis (= geniculatus Managabeira): Forattini 1973: 124 (in part, figs.). Forattini & Galati 1977: 26 (♀). Biancardi 1982: 178 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil).

Distribution (Map 33-14). Belize (Martins et al. 1978); Costa Rica (Murillo and Zeledón 1985); Panama (Fairchild & Hertig 1951a); Colombia (Young 1979, in part; Morales & Minter 1981); Ecuador (Young 1979); Peru (Llanos et al. 1975b); Brazil (Martins et al. 1978; Arias, 1987, unpubl. data); French Guiana (♂♂, Maripasoula & Saul, E. Abonnenc).

Remarks. The presence of L. geniculata in a given locality must be confirmed when males are available; therefore, collecting data based on females alone are questionable. These include listings from Nicaragua (Zeledón & Murillo 1983); Panama & Colombia (Young 1979, in part); Brazil (Fraiha et al. 1978; Arias & Freitas 1977, 1978; Lainson et al. 1983); Suriname (Hudson & Young 1985). Ryan (1986) illustrated the spermathecae of L. geniculata from a reared female and noted that it and L. corossonensis could not be distinguished with certainty.

Lutzomyia (Psychodopygus) guyanensis (Floch & Abonnenc)

Phlebotomus guyanensis Floch & Abonnenc 1941a: 18 (♀, Montagne Lucifer, French Guiana); 1952: 173 (? ♀).

Lutzomyia guyanensis: Barretto 1962: 94 (listed).

Psychodopygus guyanensis: Forattini 1971: 105 (listed).

Distribution (Map 33-10) French Guiana (Floch & Abonnenc 1941a).

Remarks. This species was described from a single female that is now apparently lost (F. Rodhain, Inst. Pasteur Paris, pers. comm. 1987). Floch & Abonnenc (1952) redescribed the species but figured another specimen from Crique-Anguille, French Guiana. As mentioned earlier, the guyanensis male is probably L. corossoniensis, L. geniculata, or L. dorlinsis but this confusing matter can be settled only when additional topotypes are obtained and reared to properly associate the sexes.

Records of L. guyanensis in Suriname (Martins et al. 1978) and elsewhere are considered questionable.

Lutzomyia (Psychodopygus) dorlinsis (Le Pont & Desjeux)

Plate 33-12

Psychodopygus dorlinsis Le Pont & Desjeux 1982: 279 (♂, near Maripasoula, French Guiana.

Lutzomyia dorlinsis: Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 33-5). French Guiana (Le Pont & Desjeux 1982); Brazil (J. Arias, unpub. data).

Remarks. The male of L. dorlinsis closely resembles those of L. geniculata and L. corossonensis but can be separated from them by the shorter length of the paramere and its shape.

Lutzomyia (Psychodopygus) sp. of Tres Esquinas Young

Plate 33-12

Lutzomyia sp. of Tres Esquinas Young 1979: 195 (♀, Tres Esquinas, Caqueta, Colombia). Morales & Minter 1981: 97 (Caqueta, Colombia).

Distribution (Map 33-10). Colombia (above refs.); Brazil (♀, Amazonas, J. Arias).

Remarks. The female of this informally named taxon resembles those of L. geniculata and L. corossoniensis (see Ryan 1986) but the male has not been discovered.

Lutzomyia (Psychodopygus) matosi (Barretto & Zago)

Plate 33-13

Sergentomyia matosi Barretto & Zago 1956: 180 (♂, Itaipaua, Petropolis, Rio de Janeiro, Brazil).

Lutzomyia matosi: Barretto 1962: 94 (listed). Theodor 1965: 189 (listed). Barretto 1966: 135 (♀ descript.). Martins et al. 1978: 48 (refs., dist.).

Psychodopygus matosi: Forattini 1971a: 105 (listed); 1973: 413 (figs., tax.).

Distribution (Map 33-8). Brazil (Martins et al. 1978).

Remarks. The male of L. matosi is easily recognized by the dorsal tuft of long setae on the paramere.

## Lutzomyia (Psychodopygus) arthuri (Fonseca)

Plate 33-14

Flebotomus arthuri Fonseca 1936: 324 (♀, Serra da Cantareira, Sao Paulo, Brazil). Barretto 1947a: 186 (refs., in part).

Flebotomus lloydi (not lloydi Antunes): Coutinho 1940a: 321 (♂).

Phlebotomus arthuri (in part): Barretto 1959a: 107 (keyed). Fairchild & Hertig 1951a: 401 (keyed, tax.). Floch & Abonnenc 1952: 16 (keyed, figs.). Ortiz 1972b: 225 (keyed, figs.).

Lutzomyia arthuri: Barretto 1962: 94 (listed). Barretto 1966: 144 (keyed). Martins et al. 1978: 45 (in part, dist.).

Psychodopygus arthuri: Forattini 1971a: 104 (listed); 1973: 403 (in part, figs., tax.). Galati 1981: 321 (correctly associated ♂, ♀, dist.).

Distribution (Map 33-5). Brazil (Martins et al. 1978, in part).

Remarks. The thoracic pigmentation differs markedly between both sexes of L. arthuri and L. lloydi (cf. Plates 33-14 & 33-15). Galati (1981) was the first to point out that the male, described as the former species by Fonseca, was actually that of L. lloydi.

Barretto (1941a) described the immature stages of L. arthuri from reared specimens. Only $F_1$ females were obtained.

## Lutzomyia (Psychodopygus) lloydi (Antunes)

Plate 33-15

Flebotomus lloydi Antunes 1937: 24 (♀, Perús, São Paulo, Brazil). Barretto 1947a: 207 (refs., in part).

Flebotomus arthuri (not arthuri Antunes): Fonseca 1939: 181 (♂).

Phlebotomus lloydi (in part): Barretto 1950a: 107 (keyed). Fairchild & Hertig 1951a: 401 (keyed). Floch & Abonnenc 1952: 36 (keyed, figs.).

Flebotomus rachoui Damasceno & Arouck 1956: 3 (♂, Minas Gerais, Brazil). Galati 1981. Rev. Brazil. Ent. 25: 322 (as junior synonym of L. lloydi).

Lutzomyia lloydi: Barretto 1962: 94 (listed). Theodor 1965: 188 (listed, o fig. of arthuri = lloydi). Martins et al. 1978: 46 (in part, refs., dist.).

Psychodopygus lloydi: Forattini 1971a: 105 (listed); 1973: 412 (in part, figs., tax.). Galati 1981: 322 (dist., correctly associated ♂, ♀).

Distribution (Map 33-10). Brazil (Martins et al. 1978, in part).

Remarks. Martins et al. (1978) regarded L. rachoui (Damasceno & Arouck) as a junior synonym of L. arthuri; however, it is conspecific with L. lloydi (Galati 1981).

Barretto (1943b) observed that females of L. lloydi are attracted to light and will bite man occasionally in the laboratory.

## Lutzomyia (Psychodopygus) davisi (Root)

Plate 33-16

Phlebotomus davisi Root 1934: 242 (♂, Fordlandia, Pará, Brazil; ♀ not conspecific).

Phlebotomus rooti Mangabeira 1942a: 112 (Aura, Belém, Pará, Brazil). Forattini 1971a: 105 (as synonym of davisi).

Lutzomyia davisi: Theodor 1965: 188. Llanos 1973: 30 (figs., Peru). Martins et al. 1973b: 419 (♀ descript.). Llanos et al. 1975b: 630; 1976: 480 (Peru). Arias & Freitas 1977: 511 (Amazonas, Brazil). Martins et al. 1978: 41 (refs., dist.). Arias & Freitas 1978: 391 (negative for flagellates, Brazil). Young 1979: 183 (figs., refs.). Abonnenc et al. 1980: 708 (♂, ♀, tax.). Le Pont & Pajot 1980: 64 (cf. to claustrei). Morales & Minter 1981: 97 (Colombia). Aguiar & Soucasaux 1984: 199 (seasonal biting habits). Young & Rogers 1984: 605 (figs., keyed, Ecuador). Young et al. 1985: 144 (Peru). Aguiar et al. 1985a-c (coll. data, Brazil). Vexenat et al. 1986: 296 (Bahia, Brazil). Ready et al. 1986: 26 (Pará, Brazil). Geoffroy et al. 1986: 486 (French

Guiana). Young et al. 1987: 588 (Norte de Santander, Colombia). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus davisi: Forattini 1973: 163 (in part, tax.). Ward & Ready 1975: 128 (egg). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Ward 1976: 233 (larva). Fraiha et al. 1978: 36 (Pará, Brazil). Lainson et al. 1979: 241 (negative for flagellates, Brazil). Fraiha & Ward 1980b: 16 (cf. to amazonensis). Fraiha et al. 1980b: 21 (Peru). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Lainson et al. 1983: 326 (Marajo Island, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 132 (figs., Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan et al. 1986: 26 (Pará, Brazil). Ryan et al. 1987a: 356 (unident. flagellates, Brazil).

Lutzomyia rooti: Martins et al. 1973b: 419 (as synonym or davisi). Leger et al. 1977: 225 (French Guiana). Abonnenc et al. 1979: 85 (cf. to claustrei).

Psychodopygus rooti: Ward et al. 1973: 178 (Pará, Brazil). Lainson et al. 1973: 190 (Pará, Brazil).

Distribution (Map 33-11). Colombia (Young 1979; Morales & Minter 1981; Young et al. 1987); Ecuador (Young 1979); Peru (Llanos 1981; Young et al. 1985); Bolivia (Martins et al. 1978; Le Pont & Desjeux 1986); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982;

Aguiar & Soucasaux 1984; Ryan 1986); French Guiana (Leger et al. 1977; Abonnenc et al. 1980; Geoffroy et al. 1986).

Remarks. Lutzomyia davisi is locally common in the Amazon Basin; populations extend northwards to Norte de Santander Dept., Colombia. Females are highly anthropophilic and have frequently been misidentified as other Psychodopygus spp. (see Young 1979).

Lutzomyia (Psychodopygus) claustrei Abonnenc, Léger & Fauran

Plate 33-17

Lutzomyia claustrei Abonnenc, Léger & Fauran 1979: 80 (♂, Maripasoula, French Guiana). Le Pont & Pajot 1980: 62 (♀, French Guiana). Abonnenc et al. 1980: 715 (♀, French Guiana & Brazil records). Léger et al. 1980: 116 (French Guiana). Young & Rogers 1984: 605 (♂, ♀ figs., keyed). Young et al. 1985: 144 (Peru). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 29 (in Disney traps, Pará, Brazil). Young & Morales 1987: 664 (Meta, Colombia). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus claustrei: Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan 1986: 131 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (nat. infection unident. flagellates, Brazil).

Distribution (Map 33-12). Colombia (Young & Morales 1987); Suriname (Hudson & Young 1985); French Guiana (Abonnenc et al. 1980); Brazil (Biancardi et al. 1982; Ryan 1986); Peru (Young et al. 1985).

Remarks. Ryan et al. (1987c) isolated unidentified Leishmania from L. claustrei collected in northern Brazil.

Lutzomyia (Psychodopygus) amazonensis (Root)

Plate 33-18

Phlebotomus amazonensis Root 1934: 244 (♀, Iquitos, Peru). Forattini 1960: 160 (Amapa, Brazil).

Lutzomyia amazonensis: Theodor 1965: 188 (listed). Arias & Freitas 1977: 510 (Amazonas, Brazil); 1978: 391 (negative for flagellates, Brazil). Le Pont & Desjeux 1980: 64 (cf. to claustrei). Morales & Minter 1981: 105 (Caqueta, Colombia). Young & Rogers 1984: 605 (♂, ♀ figs., keyed). Hudson & Young 1985: 418 (Suriname). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus amazonensis: Forattini 1973: 401 (♀, tax.). Fraiha et al. 1978: 136 (Brazil records); 1980a: 5 (tax.). Fraiha & Ward 1980a: 13 (cf. to llanosmartinsi); 1980b: 15 (♂). Biancardi et al. 1982: 178 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 128 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 356 (dissection results, Brazil).

Lutzomyia robini Abonnenc, Arias, Léger & Young 1980: 711 (♂, ♀, Maripasoula, French Guiana). Biancardi et al. 1982: 178 (as synonym of amazonensis).

Distribution (Map 33-13). Colombia (Morales & Minter 1981); Ecuador (Young & Rogers 1984); Peru (Root 1934; Fraiha et al. 1980b); French Guiana (Abonnenc et al. 1980); Suriname (Hudson & Young 1985); Brazil (Forattini 1960; Arias & Freitas 1978, 1982; Biancardi et al 1982; Ryan 1986); Bolivia (Le Pont & Desjeux 1986).

## Lutzomyia (Psychodopygus) parimaensis (Ortiz & Alvarez)

Phlebotomus parimaensis Ortiz & Alvarez 1972: 141 (♀, Serra Parima, Amazonas, Venezuela).

Lutzomyia parimaensis: Martins et al. 1978: 169 (as inadequately described species). Young 1979: 184 (possibly = L. davisi). Feliciangeli 1980: 246 (♀ figs., keyed).

Distribution (Map 33-16). Venezuela (type locality).

Remarks. No specimens referable to L. parimaensis can be located in Venezuelan collections (D. Feliciangeli, pers. comm.). There is a strong possibility that L. parimaensis is conspecific with a described species in the subgenus.

## Lutzomyia (Psychodopygus) llanosmartinsi (Fraiha & Ward)

Plate 33-19

Psychodopygus llanosmartinsi Fraiha & Ward 1980a: 10 (♂, ♀, Pilcopata, Cuzco, Peru). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Le Pont & Desjeux 1986: 314 (natural Leishmania infection, Bolivia).

Lutzomyia amazonensis (not amazonensis Root): Llanos et al. 1975a: 665 (♂, ♀ figs., biting man): 1975b: 669 (Peru).

Phlebotomus llanos-martinis: Desjeux et al. 1987: 744 (as probable Leishmania vector, Bolivia).

Distribution (Map 33-14). Brazil (Biancardi et al. 1982; ♂♂, ♀♀, Costa Marquez, Rondonia, 1987, flight trap, T. Klein); Peru (Llanos et al. 1975a,b); Bolivia (Le Pont & Desjeux 1986).

## Lutzomyia (Psychodopygus) recurva Young

Plate 33-20

Lutzomyia recurva Young 1973: 106 (♂, ♀, Curiche, Choco, Colombia). Martins et al. 1978: 45. Young 1979: 193 (♂, ♀ figs.). Christensen et al. 1983: 466 (Panama).

Distribution (Map 33-11). Panama; Colombia (Young 1979).

Remarks. Lutzomyia recurva apparently has a limited geographic distribution; all known specimens have been taken only in Choco Dept., Colombia, and nearby Darien Prov., Panama.

## Lutzomyia (Psychodopygus) panamensis (Shannon)

Plate 33-21

Phlebotomus panamensis Shannon 1926: 192 (♂, Canal Zone, Panama). Fairchild & Hertig 1951a: 399 (♂, ♀, figs., tax., refs.).

Lutzomyia panamensis: Barretto 1962: 94 (listed). Theodor 1965: 188 (figs.). Zimmerman et al. 1977: 575 (egg). Leger et al. 1977: 224 (o fig., French Guiana). Mogollon et al. 1977: 209 (Venezuela). Martins et al. 1978: 43 (figs., dist.). Arias & Freitas 1978: 391 (negative for flagellates, Brazil). Ramirez Perez et al. 1978: 52 (Venezuela). Young 1979: 190 (figs., refs., dist.). Porter & De Foliart 1981: 147 (biting habits, Colombia). Christensen & Herrer 1980b: 523 (feeding habits). Feliciangeli 1980: 246 (keyed). Le Pont & Pajot 1980: 64 (cf. to claustrei). Lewis & Macfarlane 1981: 179 (mite parasite, Panama). Ramirez Perez et al. 1981: 114 (pop. dynamics, age grading Venezuela). Chaniotis et al. 1982: 3 (control, Panama). Ramirez Perez et al. 1982a: 14 (♂, ♀ figs.. Venezuela); 1982b: 58 (Venezuela). Zeledón et al. 1982: 276 (Honduras). Zeledón & Murillo 1983: 280 (Nicaragua). Williams 1983: 489 (♀ fig., tax.). Christensen et al. 1983: 465 (Panama). Young & Rogers 1984: 599 (listed, Ecuador). Hashiguchi et al. 1985a: 442 (Ecuador). Murillo & Zeledón 1985: 60 (♂, ♀ figs., Costa Rica). Porter et al. 1987: 929 (Guatemala). Lebbe et al. 1987:

29 (computer aided ident.). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela).

Psychodopygus panamensis: Lewis 1965: 376 (internal morphol.). Forattini 1973: 89 (♂, ♀ figs., tax.). Ward 1976: 239 (larva keyed).

Distribution (Map 33-13). Mexico; Belize (Martins et al. 1978); Guatemala (Porter et al. 1987); Honduras (Zeledón et al. 1982); Nicaragua (Fairchild & Hertig 1959); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Morales et al. 1981); Ecuador (Young 1979; Hashiguchi et al. 1985a); Brazil (Martins et al. 1978); French Guiana (Leger et al. 1977); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978; 1981; 1982a, 1982b; Feliciangeli 1987a); Brazil (Martins et al. 1978).

Remarks. The record of L. panamensis from Iquitos, Peru (Root 1934), is questionable although the spermathecae figured by Root closely resemble those of this species.

Porter & De Foliart (1981) reviewed the man biting habits, behavior, seasonal abundance, etc., of L. panamensis based on their studies in Colombia and that of others. In Panama, L. panamensis is regarded as a natural vector of Leishmania panamensis (see Christensen et al. 1983 for additional information and references).

## Lutzomyia (Psychodopygus) hirsuta nicaraguensis

(Fairchild & Hertig)

Plate 33-22

Phlebotomus nicaraguensis Fairchild & Hertig 1961a: 26 (♂, Villa Somoza, Nicaragua).

Lutzomyia nicaraguensis: Barretto 1962: 94 (listed). Theodor 1965: 188. Christensen et al. 1983: 466 (listed, Panama).

Psychodopygus nicaraguensis: Forattini 1971a: 105; 1973: 413 (♂ fig.).

Lutzomyia hirsuta nicaraguensis: Young 1979: 189 (tax.). Williams 1983: 489 (tax.).

Distribution (Map 33-15). Nicaragua (Fairchild & Hertig 1961a); Panama (Young 1979).

## Lutzomyia (Psychodopygus) hirsuta hirsuta (Mangabeira)

Plate 33-22

Flebotomus hirsutus Mangabeira 1942a: 116 (♂, Abaeté, Pará, Brazil).

Phlebotomus colas-belcouri Floch & Chassignet 1947a: 1 (♂, Baduel, French Guiana). Barretto 1953: 209 (as synonym of hirsutus).

Lutzomyia hirsuta: Barretto 1962: 94; 1966: 134 (refs.). Leger et al. 1977: 218 (French Guiana). Arias & Freitas 1977: 511 (Amazonas, Brazil); 1978: 39 (negative for flagellates, Brazil). Martins et al. 1978: 42 (dist.). Leger et al. 1980: 116 (French Guiana). Young & Rogers 1984: 599 (listed, Ecuador). Aguiar & Soucacaux 1984: 199 (seasonal biting habits, Brazil). Aguiar et al. 1985a-c; 1986 (ecology, Brazil). Aguiar & Vilela 1987: 585 (resting sites, Brazil). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus hirsutus: Forattini 1971a: 105; 1973: 412 (o fig., tax.). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Lainson et al. 1979: 241 (negative for flagellates, Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Ryan et al. 1987a: 355 (natural Leishmania infections, Brazil).

Phlebotomus paraensis (not paraensis Costa Lima): Llanos 1973: 30 (Peru).

Lutzomyia hirsuta hirsuta: Young 1979: 188 (figs., refs.). Young & Rogers 1984: 599 (listed, Ecuador). Hudson & Young 1985: 418 (Suriname). Young et al. 1985: 145 (Madre de Dios, Peru).

Psychodopygus hirsutus hirsutus: Le Pont & Desjeux 1986: 314 (Bolivia). Ryan 1986: 133 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 33-15). Colombia (Young 1979; ♂♂, ♀♀, Leticia, Amazonas, 1986-1987, A. Morales et al.); Ecuador (Young 1979); Peru (Llanos 1973, as paraensis; Young et al. 1985); Bolivia (Velasco 1973, as sp. C; Le Pont & Desjeux 1986); Brazil (Lainson et al. 1976; Martins et al. 1978; Fraiha et al. 1978; Arias & Freitas 1977; 1978; Biancardi et al. 1982; Ryan 1986; Vexenat et al. 1986); French Guiana (Leger et al. 1977; 1980; Martins et al. 1978); Suriname (Hudson & Young 1985).

Remarks. This species is often with L. davisi in the Amazon basin in man biting collections. Leishmania (Viannaia) sp. was identified in the guts of 3 L. h. hirsuta captured at Tucurui, Pará State, Brazil, by Ryan et al. (1987a), but its role as a vector to man remains to be determined.

## Lutzomyia (Psychodopygus) paraensis (Costa Lima)

Plate 33-23

Flebotomus paraensis Costa Lima 1941: 7 (♂, Aurá, Belém, Pará, Brazil).

Lutzomyia paraensis: Barretto 1962: 94 (listed). Theodor 1965: 188 (listed). Arias and Freitas 1977: 511 (Amazonas, Brazil); 1978: 391 (negative for flagellates, Brazil). Leger et al. 1977: 225 (French Guiana). Martins et al. 1978: 44 (♀ fig., dist., in part). Le Pont & Pajot 1980: 64 (cf. to claustrei). Leger et al. 1980: 116 (French Guiana). Morales & Minter 1981: 105 (Colombia). Young & Rogers 1984: 605 (Ecuador). Young et al. 1985: 145 (Peru). Ready et al. 1986: 26 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus paraensis: Forattini 1971a: 105 (listed); 1973: 413 (in part, tax., figs.). Ward & Ready 1975: 128 (egg). Ward 1976: 233 (larva). Fraiha et al. 1978: 136 (Pará, Brazil records). Lainson et al. 1979: 241 (negative for flagellates, Brazil). Fraiha et al. 1980b: 21 (Peru). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Arias et al. 1985: 1101 (natural Leishmania infections, Brazil). Ryan 1986: 134 (♂, ♀ figs., Pará, Brazil). Ryan et al. 1987a: 355 (unidentified flagellate infections, Brazil).

Distribution (Map 33-16). Colombia (Morales & Minter 1981; ♂♂, ♀♀ Leticia, Amazonas, 1986-1987, A. Morales, C. Ferro & D.G. Young). Ecuador (Young & Rogers 1984); Peru (Fraiha et al. 1980b; Llanos 1981; Young et al. 1985); Brazil (Martins et al. 1978, in part; Arias & Freitas 1977; 1982; Fraiha et al. 1978; Biancardi et al. 1982; Ryan 1986); French Guiana (Leger et al. 1977; 1980); Suriname (Martins et al. 1978).

Remarks. Lutzomyia paraensis is apparently widespread in the Amazon basin. Both sexes resemble those of L. llanosmartinsi in coloration but L. paraensis is more closely related to L. ayrozai, the female of which lacks a subspherical hump between the inner pair of horizontal teeth in the cibarium. Forattini (1973) mistakenly figured the spermathecae of L. davisi as that of L. paraensis and erroneously treated L. carrerai and L. fairchildi as junior synonyms of L. paraensis.

Lutzomyia (Psychodopygus) ayrozai (Barretto & Coutinho)

Plate 33-24

Phlebotomus ayrozai Barretto & Coutinho 1940: 131 (♂, São Paulo, Brazil).

Lutzomyia ayrozai: Barretto 1962: 94 (listed). Leger et al. 1977: 223 (French Guiana). Arias & Freitas 1977: 511 (Amazonas, Brazil); 1978: 341 (negative for flagellates, Brazil). Young 1979: 175 (refs., figs., dist.). Le Pont & Pajot 1980: 64 (cf. to claustrei). Porter & De Foliart 1981: 142 (man biting habits, Colombia). Morales & Minter 1981: 97 (Colombia). Aguiar & Soucasaux 1984: 199 (seasonal biting habits, Brazil). Young et al. 1984: 599 (Ecuador). Aguiar et al. 1985b: 188; 1985c: 340; 1985d: 467; 1986: 478 (ecology, Brazil). Ready et al. 1986: 36 (Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.). Aguiar & Vilela 1987: 586 (larva recovered from leaves on forest floor, Brazil).

Lutzomyia tintinnabula Christensen & Fairchild 1971: 301 (♂, ♀, Darien, Panama). Young 1979: 175 (as synonym of ayrozai).

Psychodopygus ayrozai: Forattini 1971a: 104 (listed); 1973: 392 (in part, tax.). Forattini & Galati 1977: 25 (♀). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready et al. 1983: 780 (Pará, Brazil). Arias et al. 1985: 1101 (natural Leishmania infections, Brazil). Gomes et al. 1986: 282. Ryan 1986: 129 (figs., Pará, Brazil).

Psychodopygus tintinnabulus: Fraiha et al. 1978: 136 (Pará, Brazil). Le Pont & Desjeux 1986: 314 (Bolivia).

Lutzomyia paraensis (in part): Martins et al. 1978: 44 (dist.).

Distribution (Map 33-17). Panama (Christensen & Fairchild 1971); Colombia (Young 1979; Morales & Minter 1981); Trinidad (Young 1979); French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Brazil (Barretto 1947a; Arias & Freitas 1977, 1978; Fraiha et al. 1978; Young 1979; Biancardi et al. 1982; Aguiar & Soucasaux 1984; Ryan 1986); Bolivia (Le Pont & Desjeux 1986). Ecuador (Young & Rogers 1984).

Remarks. Lutzomyia ayrozai has been misidentified many times as other species (see Young 1979). It is not conspecific with L. paraensis as several authors, including Martins et al. (1978), have suggested. There are consistent differences in the shape and setation of the male parameres and in the distribution of thoracic pigmentation of both sexes. Adults have been found resting on the forest floor in Brazil.

## Lutzomyia (Psychodopygus) carrerai carrerai (Barretto)

Plate 33-25

Phlebotomus carrerai Barretto 1946d: 286 (♂, Restrepo, Meta, Colombia).

Sergentomyia pessoanus Barretto 1955b: 247 (♂, Itatiaia, Rio de Janeiro, Brazil). Forattini 1971b: 173 (as synonym of carrerai, paraensis & fairchildi).

Lutzomyia carrerai: Barretto 1962: 94 (listed). Barretto 1966: 143 (keyed). Martins et al. 1973a: 411 (tax.). Llanos 1975b: 670 (Peru). Arias & Freitas 1977: 511 (Amazonas, Brazil). Martins et al. 1978: 41 (refs., dist.). Le Pont & Pajot 1980: 64 (cf. to claustrei).

Lutzomyia pessoana: Barretto 1962: 94; Martins et al. 1978: 44 (dist.).

Psychodopygus carrerai: Forattini 1971a: 105 (listed). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Fraiha et al. 1978: 136 (Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 401 (Acre, Brazil). Arias et al. 1985: 1101 (natural flagellate infections, Brazil). Le Pont & Desjeux 1986: 314 (natural flagellate infection, Bolivia). Caillard et al. 1986: 489 (isozyme profiles). Ryan 1986: 130 (figs., Pará, Brazil). Ryan et al. 1987a: 356 (negative for flagellates, Brazil).

Lutzomyia carrerai carrerai: Young 1979: 178 (refs., figs.). Young & Rogers 1984: 599 (listed, Ecuador). Young et al. 1985: 144 (Peru). Le Pont et al. 1986: 79 (cf. to yucumensis, Bolivia records).

Distribution (Map 33-18). Colombia; Ecuador (Young 1979); Peru (Llanos 1975b; Young 1979; Young et al. 1985); Bolivia (Le Pont et al. 1986); Brazil (Arias & Freitas 1977; Martins et al. 1978; Fraiha et al. 1978; Ryan 1986).

Remarks. Lutzomyia c. carrerai occurs east of the Andes Mountains where it is especially common in lowland forests. We regard this subspecies as a

senior synonym of L. pessoana (Barretto). See Young (1979) for further information.

Ryan et al. (1987c) reported successful experimental transmission of Leishmania amazonensis by the bite of L. c. carrerai to a hamster.

Lutzomyia (Psychodopygus) carrerai thula Young

Plate 33-26

Phlebotomus pessoanus (not pessoana Barretto): Fairchild & Hertig 1951a: 406 (figs., Panama).

Lutzomyia carrerai thula Young 1979: 181 (♂, ♀, Cerro Campana, Panama). Williams 1983: 489 (♀ figs., tax.). Christensen et al. 1983: 466 (Panama, coll. data). Young & Rogers 1984: 599 (listed, Ecuador). Murillo & Zeledón 1985: 63 (♂, ♀ figs., Costa Rica).

Lutzomyia pessoana: Zimmerman et al. 1977: 578 (egg). Christensen & Herrer 1980b: 523 (feeding habits).

Distribution (Map 33-18). Honduras (Fairchild & Hertig 1959); Costa Rica (Murillo & Zeledón 1985); Panama; Colombia; Ecuador (Young 1979).

Remarks. Fairchild & Hertig (1951a) originally treated this subspecies as L. paraensis (not paraensis Costa Lima). They and other authors who

studied sand flies in Panama and elsewhere within the geographic range of L. c. thula, also used the name, pessoana Barretto, for this taxon (see Young 1979 for refs.). Strangways-Dixon and Lainson (1966) reported the first experimental transmission of Leishmania in the Americas by the bite of "Phlebotomus pessoanus" in Belize, but the sand fly was probably conspecific with L. panamensis (Williams 1983).

## Lutzomyia (Psychodopygus) fairchildi Barretto

Plate 33-27

Lutzomyia fairchildi Barretto 1966: 136 (♂, ♀, Itatiaia, Rio de Janeiro, Brazil). Martins et al. 1973: 415; 1978 (refs., dist.).

Distribution (Map 33-1). Brazil (Martins et al. 1978).

Remarks. We examined 1 ♂, 1 ♀ topotypes of L. fairchildi, a pale species. The tips of the genital filaments of the male are hidden within the aedeagus so it was impossible to view their modifications. The lateral lobes are shorter than those of L. c. carrerai, a closely related species.

Forattini (1973) regards L. fairchildi and L. paraensis as conspecific but structural and color differences between these species are readily apparent.

Lutzomyia (Psychodopygus) yucumensis

(Le Pont, Caillard, Tibayrenc & Desjeux)

Plate 33-25

Psychodopygus yucumensis Le Pont, Caillard, Tibayrenc & Desjeux 1986: 79 (♂, ♀, Serrania del Pilon, Beni, Bolivia). Caillard et al. 1986: 589 (cf. with carrerai carrerai, isozymes). Le Pont & Desjeux 1986: 314 (Bolivia).

Psychodopygus sp. no. 2 Biancardi et al. 1982: 177 (Rondonia, Brazil).

Lutzomyia carrerai carrerai (dark form): Young et al. 1985: 144 (Madre de Dios, Peru).

Phlebotomus yucumensis: Desjeux et al. 1987: 744 (as likely vector of Leishmania, Bolivia).

Lutzomyia yucumensis: Young et al. 1987: 588 (mention).

Distribution (Map 33-3). Brazil (Biancardi et al. 1982); Peru (Young et al. 1985); Bolivia (Le Pont et al. 1986; ♂♂, ♀♀, Rio Yapancani, Santa Cruz, 1985-1987, H. Bermudez).

Remarks. Females of L. yucumensis have been found naturally infected with Leishmania braziliensis in Bolivia (Le Pont et al. 1986; Le Pont & Desjeux 1986). The species is common in other parts of Bolivia (Rio

Yapancani, Santa Cruz, H. Bermudez, pers. comm.). Peru and Brazil in lowland forests.

## Lutzomyia (Psychodopygus) nocticola Young

Plate 33-28

Lutzomyia nocticola Young 1973: 109 (♂, ♀, Rio Anori, Antioquia, Colombia). Martins et al. 1978: 43 (refs., dist.). Young 1979: 190 (figs., refs., dist.). Porter & De Foliart 1981: 157 (listed). Le Pont & Pajot 1980: 64 (cf. to claustrei). Williams 1983: 489 (tax.). Young & Rogers 1984: 599 (listed, Ecuador). Lebbe et al. 1987: 29 (computer aided ident.).

Psychodopygus nocticola: Le Pont & Desjeux 1986: 314 (Bolivia).

Distribution (Map 33-12). Panama; Colombia; Ecuador (Young 1979); French Guiana (Lebbe et al. 1987); Bolivia (Le Pont & Desjeux 1986).

Remarks. This species is mostly pale except for the scutum which has a lateral band of faint to moderate pigmentation. Dorsum of the scutum is nearly pale.

Lebbe et al. (1987) include L. nocticola in the sand fly fauna of French Guiana. We studied a female from Saul, kindly loaned to us by F. Le Pont, that appears to be conspecific with L. nocticola, but males from there are needed to confirm its presence in this area.

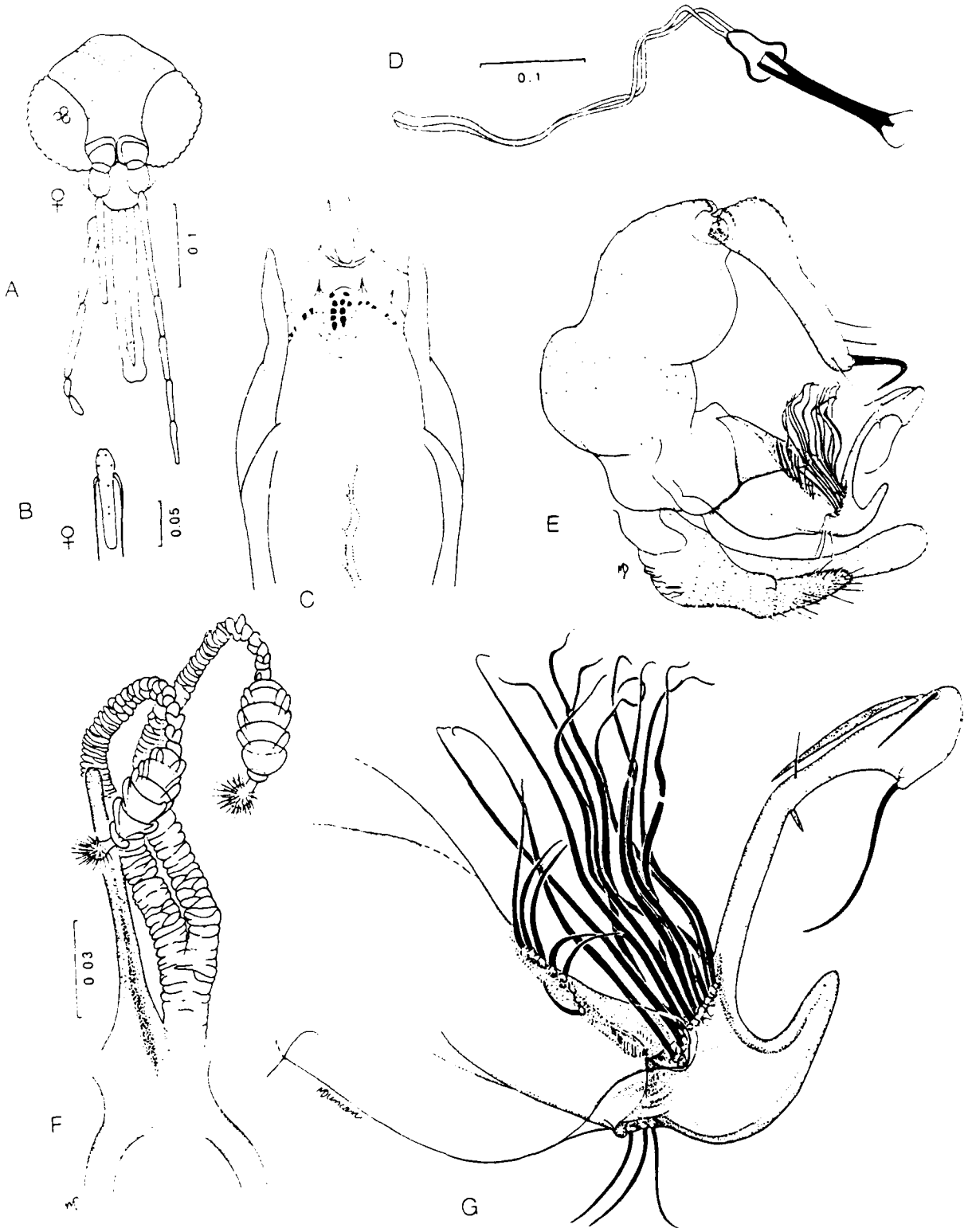



Plate 33-1

Lutzomyia bernalei. A. Female head; B. Female flagellomere II; C. Female cibarium; D. Genital pump & filaments; E. Male terminalia; F. Spermathecae; G. Paramere.

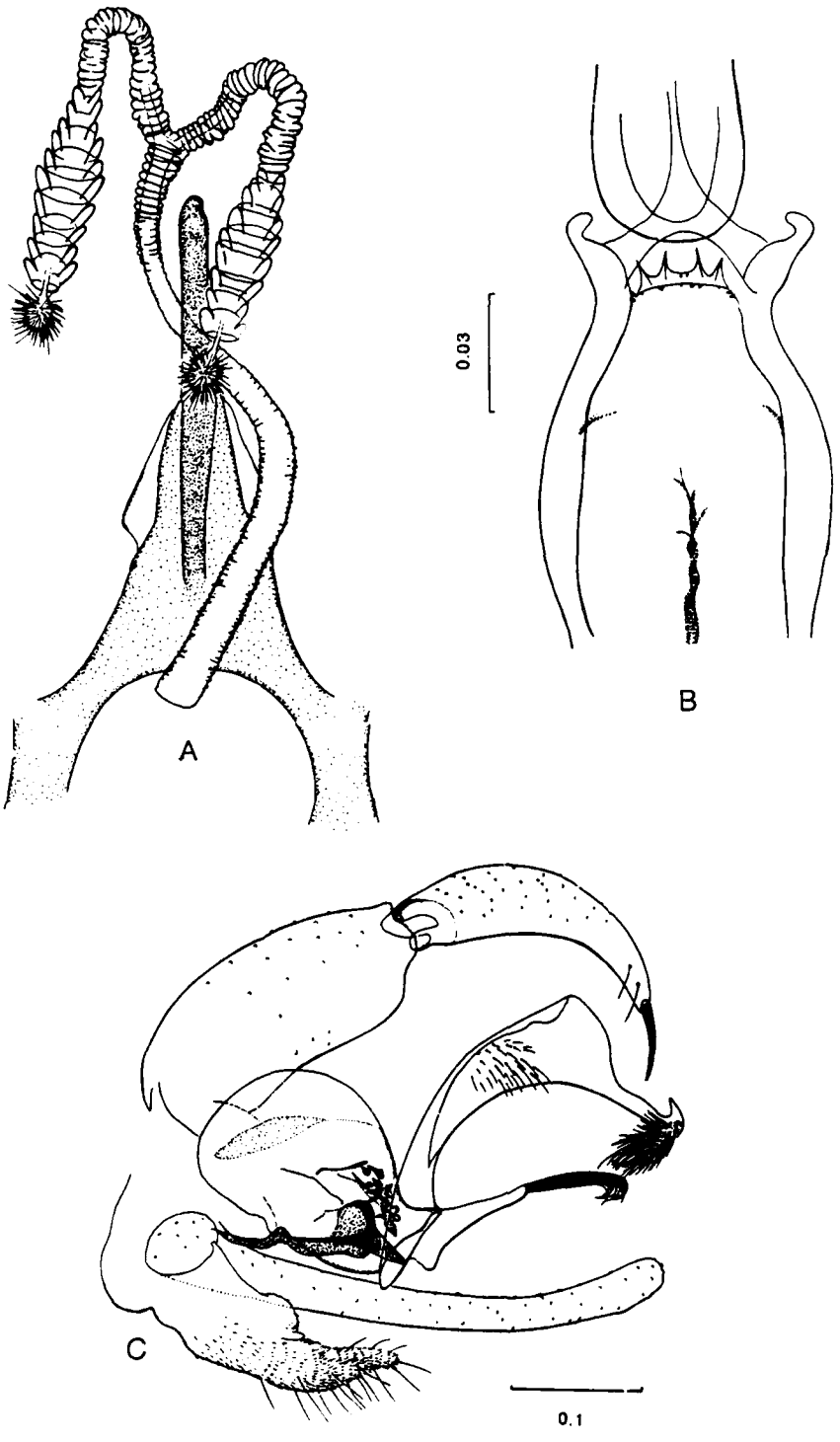



Plate 33-2

Lutzomyia lainsoni. A. Spermathecae; B. Female cibarium; C. Male terminalia.

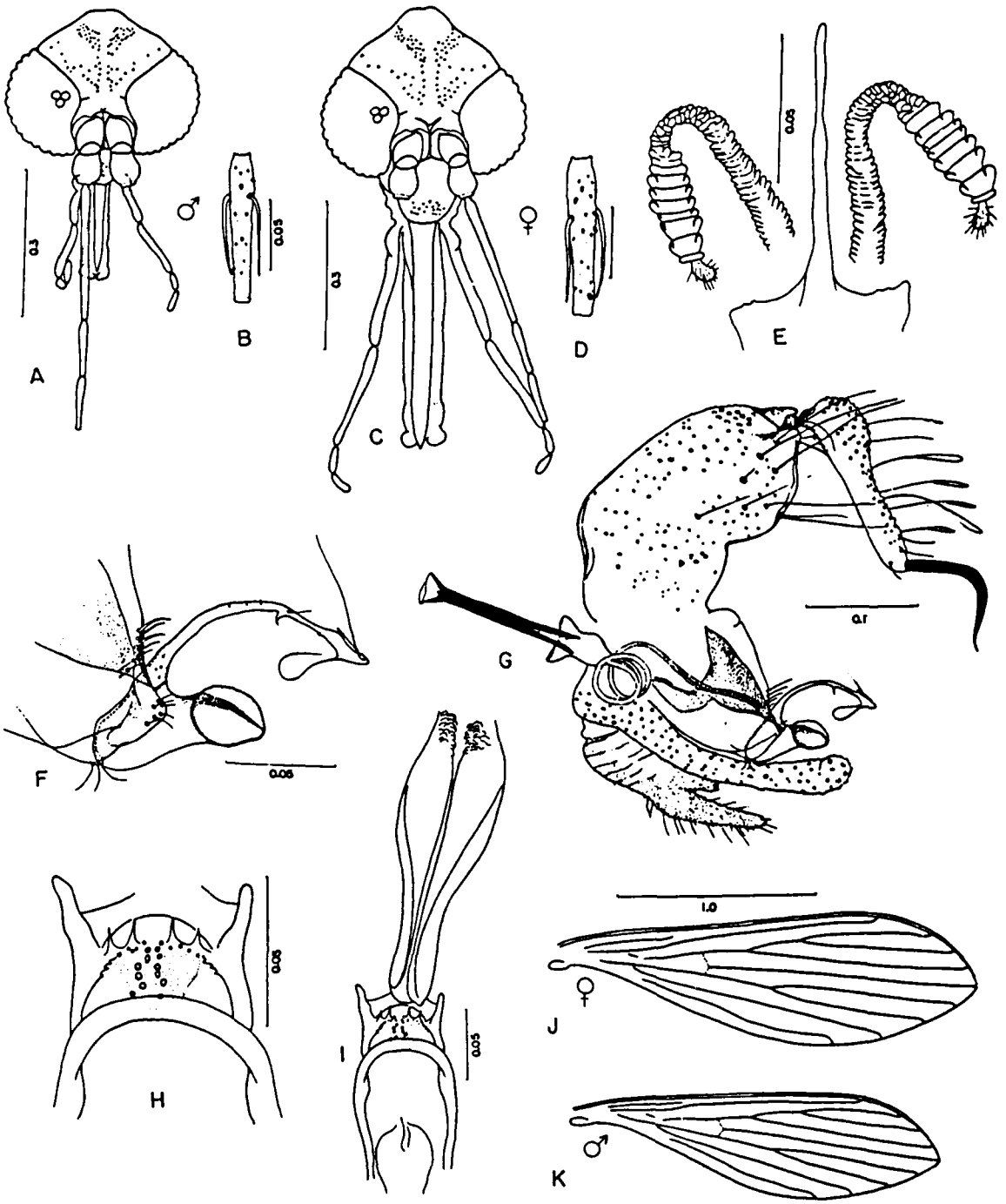



Plate 33-3

Lutzomyia fairtigi. A. Male head; B. Male flagellomere II; C. Female head; D. Male flagellomere II; E. Spermathecae; F. Paramere; G. Male terminalia; H. Female cibarium; I. Female cibarium & pharynx; J. Female wing; K. Male wing (figs. from Young 1979).

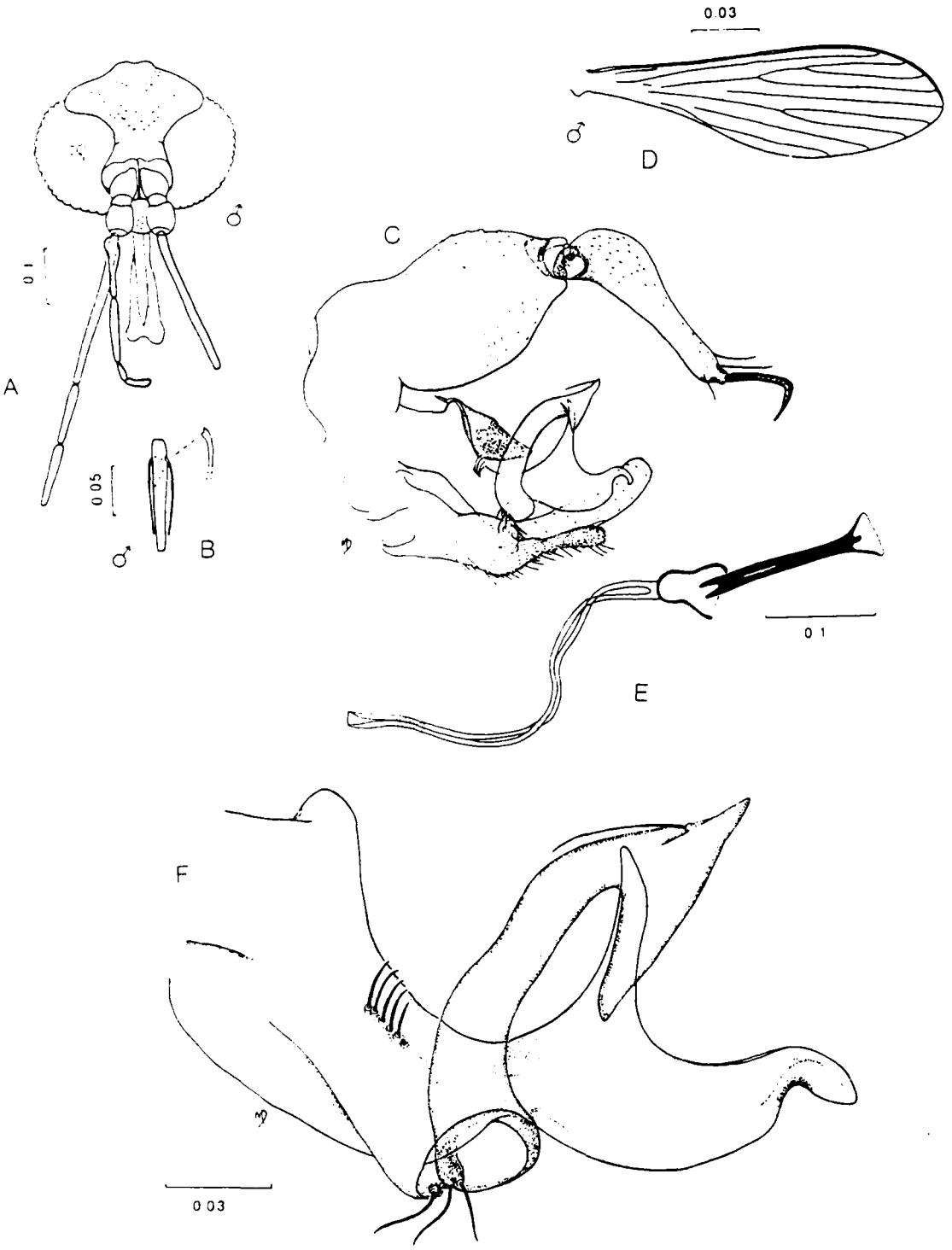



Plate 33-4

Lutzomyia wellcomei. A. Male head; B. Male flagellomere II; C. Male terminalia; D. Male wing; E. Genital pump & filaments; F. Paramere.

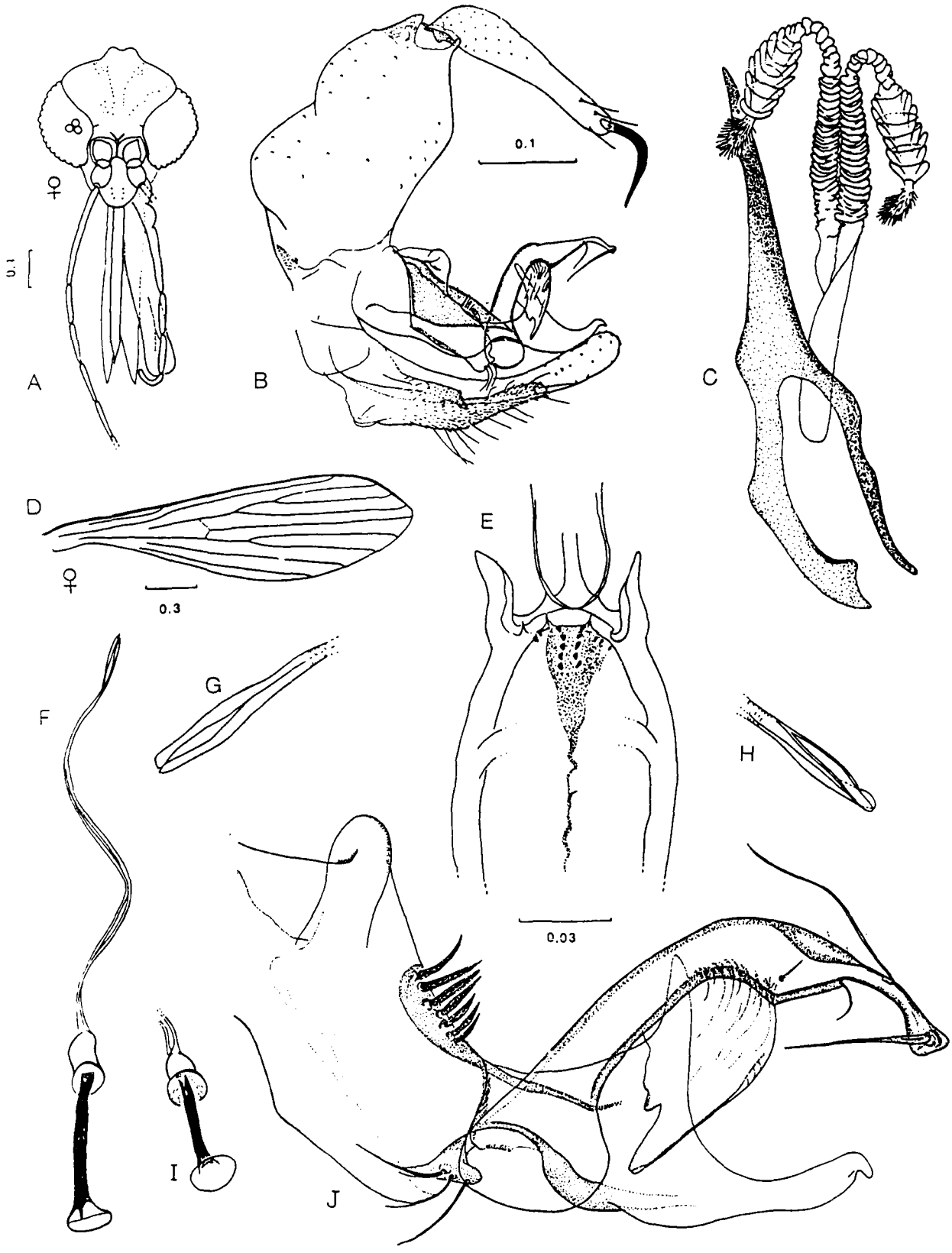
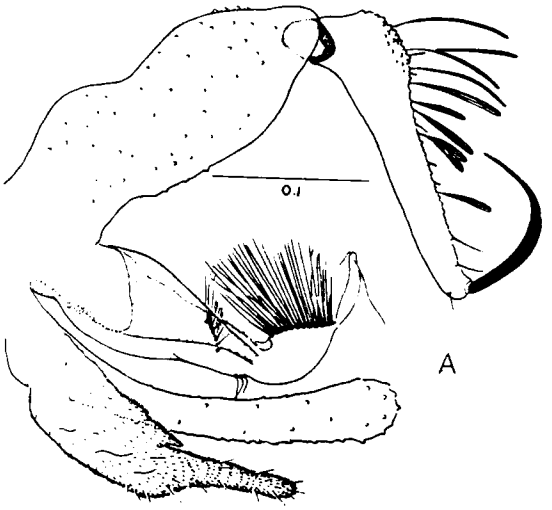



Plate 33-5

Lutzomyia complexa. A. Female head; B. Male terminalia; C. Spermathecae; D. Female wing; E. Female cibarium; F. Genital pump & filaments; G. & H. Tips of genital filaments; I. Genital pump; J. Paramere.



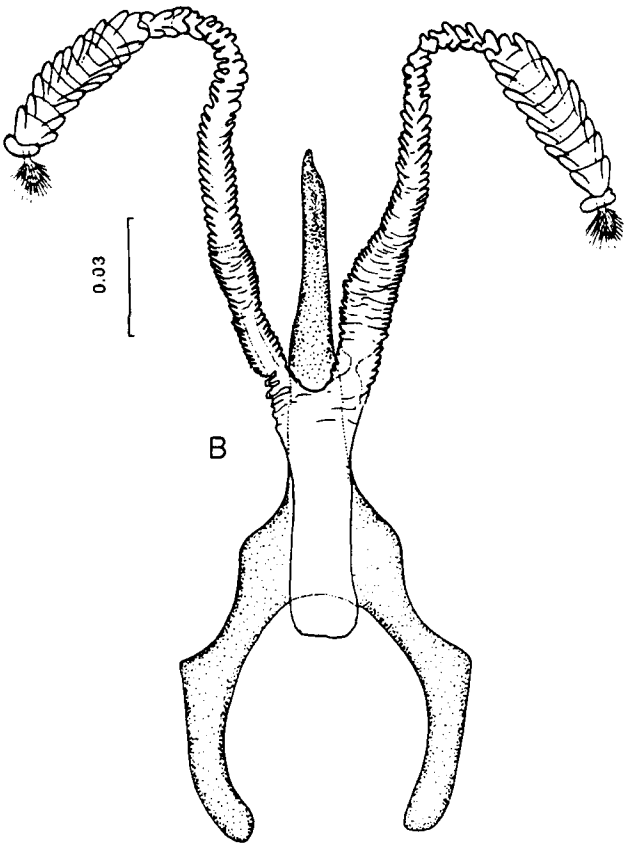




Plate 33-6

Lutzomyia chagasi. A. Male terminalia; B. Spermathecae.

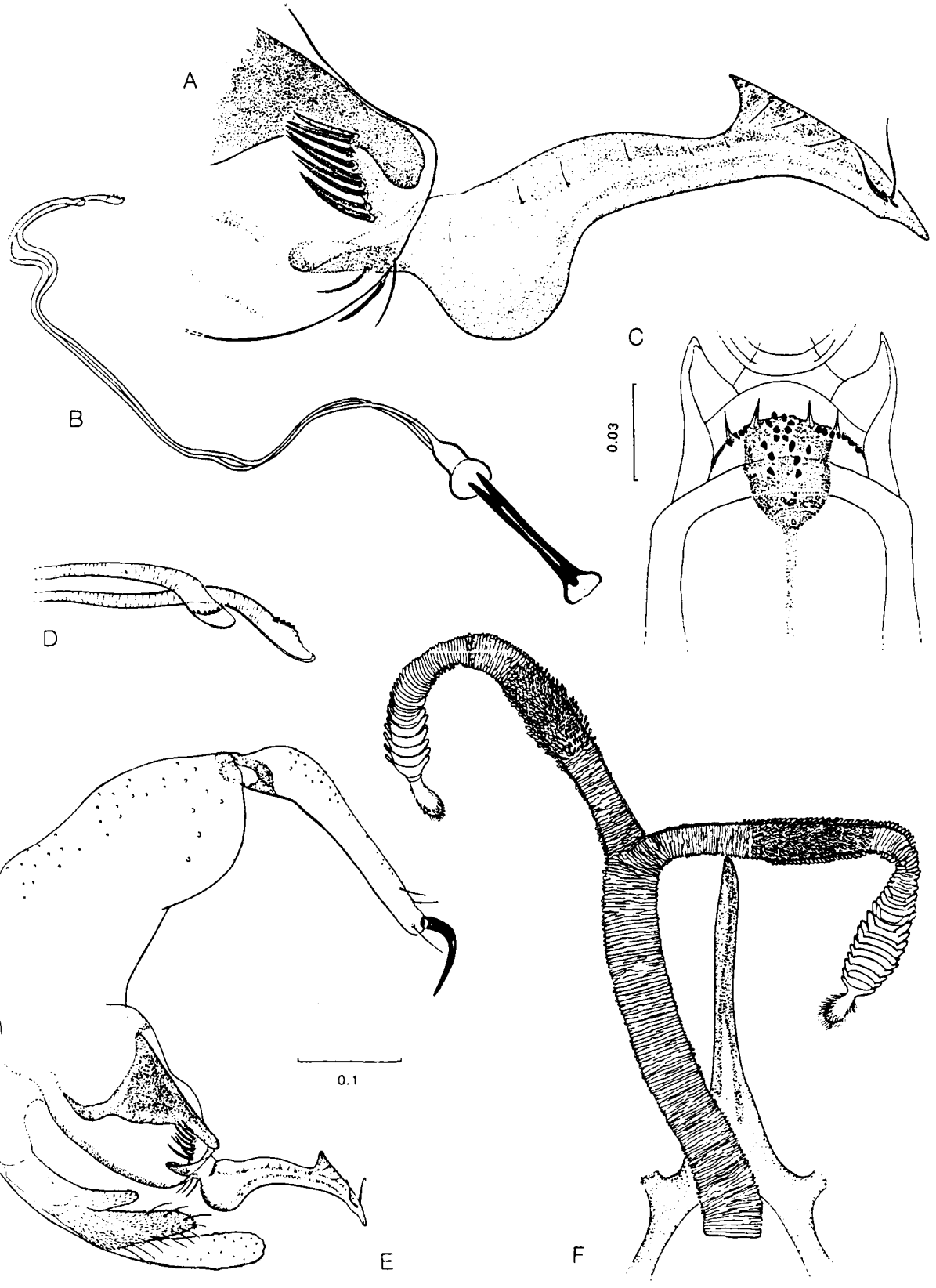



Plate 33-7

Lutzomyia leonidasdeanei. A. Paramere & aedeagus; B. Genital pump & filaments; C. Female cibarium; D. Tips of genital filaments; E. Male terminalia; F. Spermathecae.

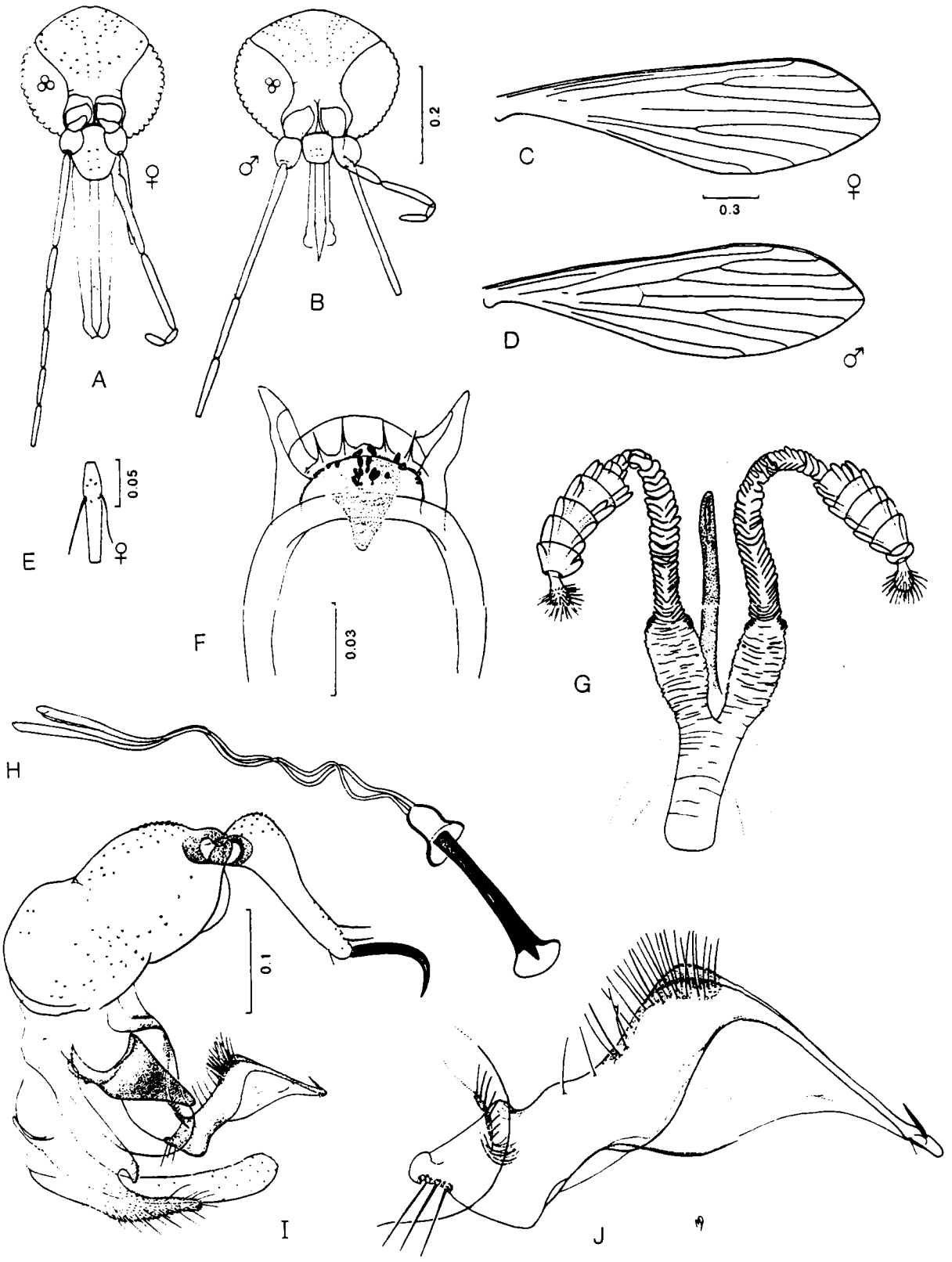



Plate 33-8

Lutzomyia (Psychodopygus) n.sp. #1. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Female flagellomere II; F. Female cibarium; G. Spermathecae; H. Genital pump & filaments; I. Male terminalia; J. Paramere.

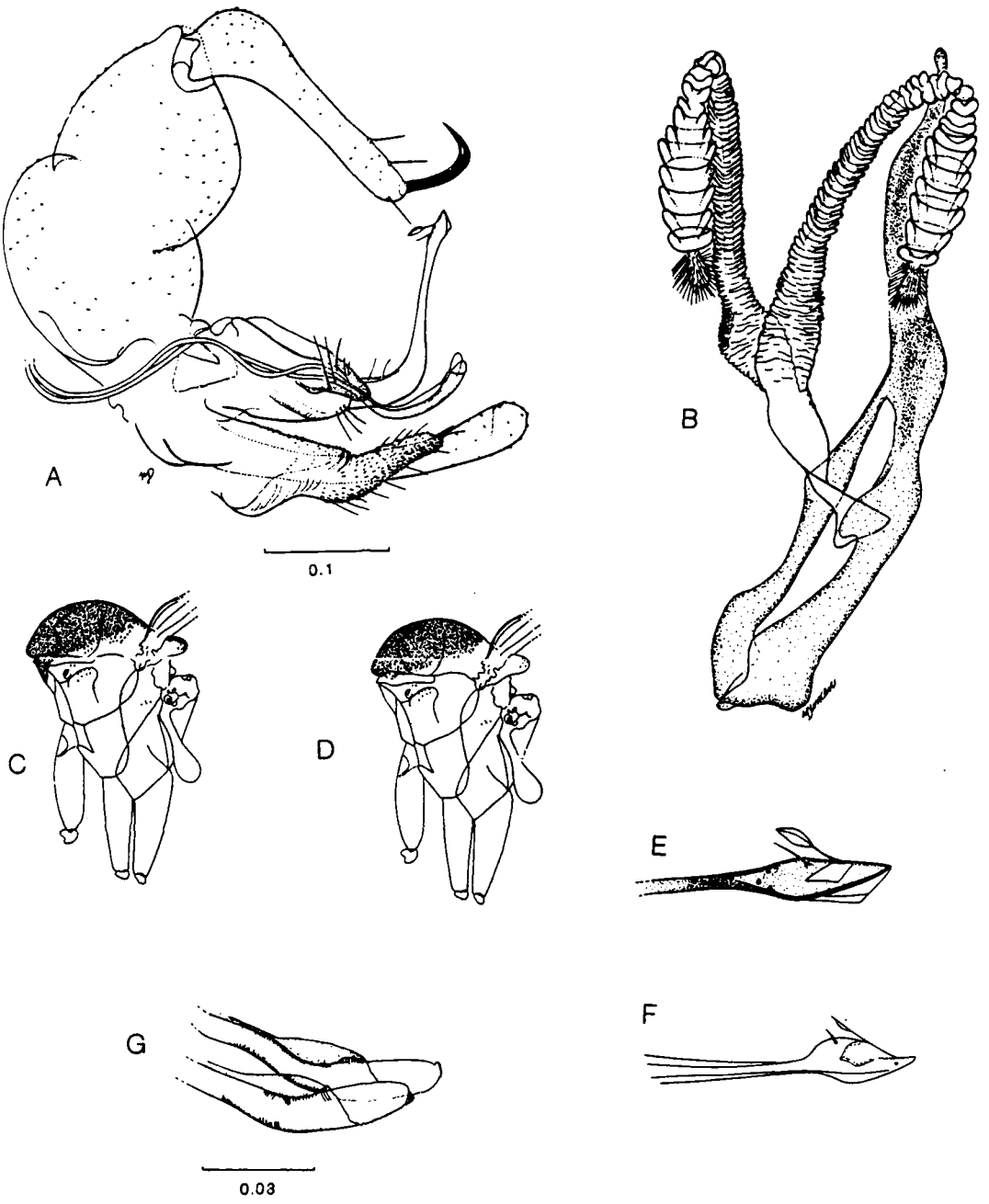



Plate 33-9

Lutzomyia squamiventris maripaensis. A. Male terminalia; B. Spermathecae; D. Thorax; E. Paramere apex; G. Tips of genital filaments.

Lutzomyia squamiventris squamiventris. C. Thorax; F. Paramere apex (fig. F from Ready et al. 1982).

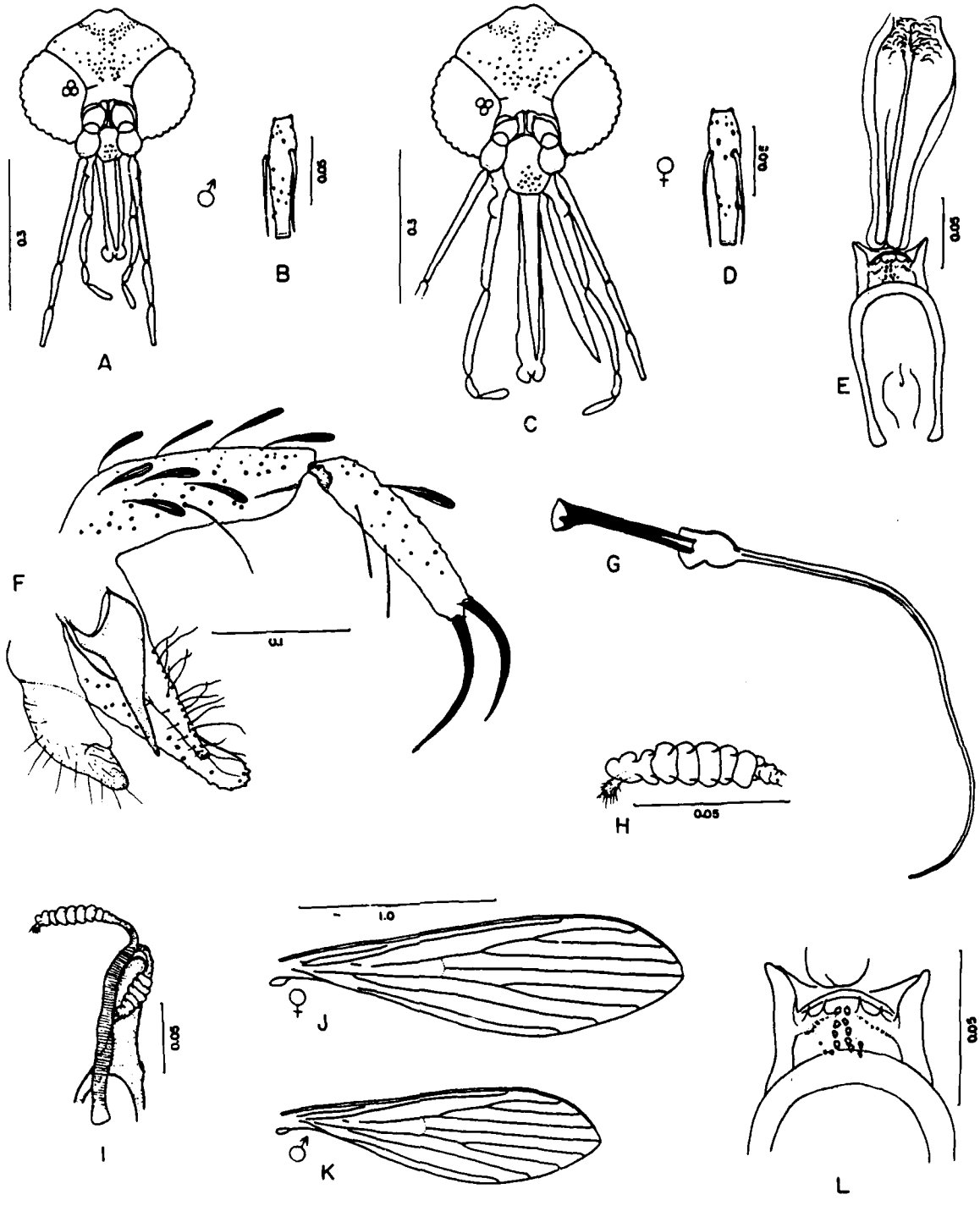



Plate 33-10

Lutzomyia bispinosa. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male genitalia; G. Genital pump & filaments; H. Body of spermathecae; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (from Young 1979).

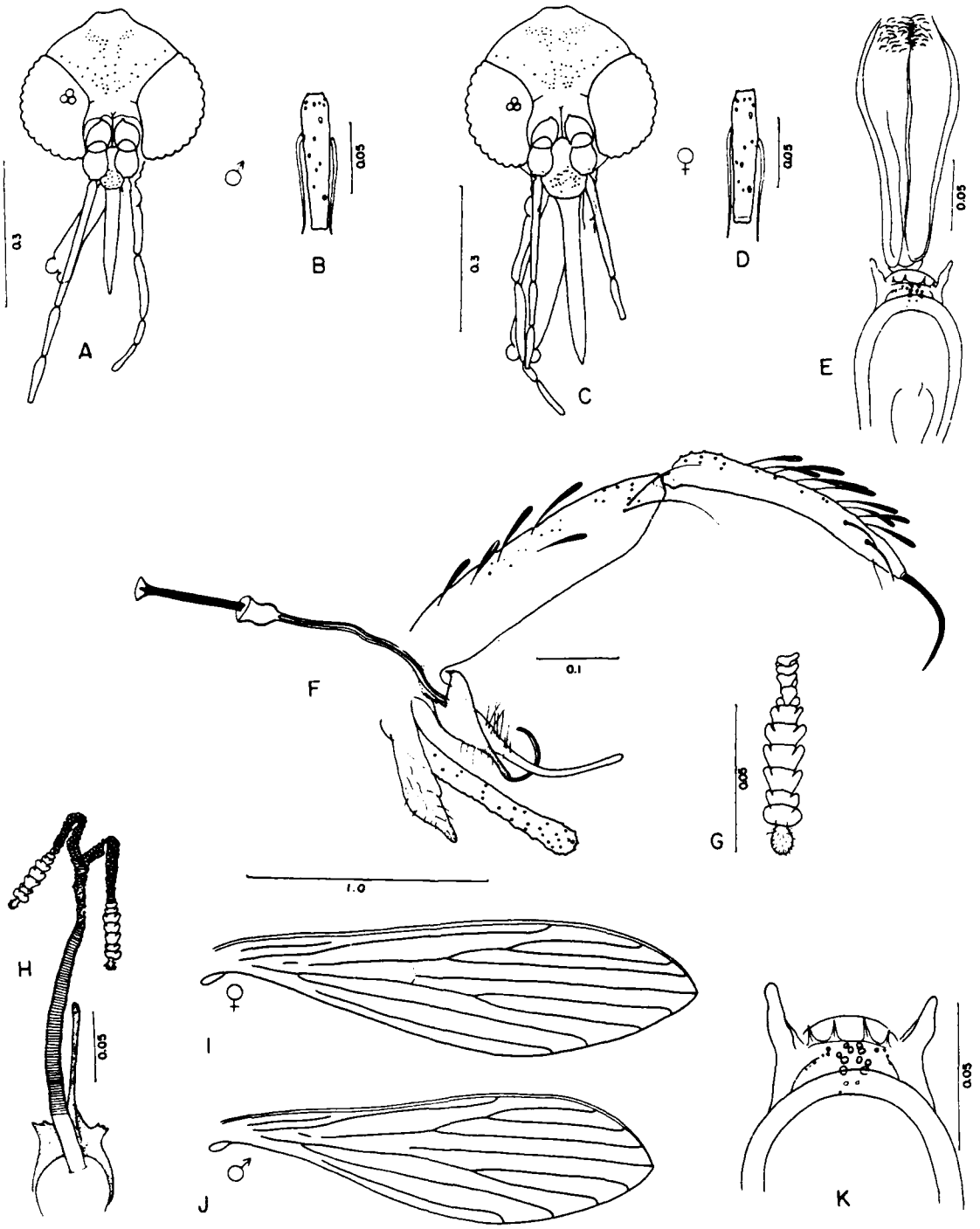



Plate 33-11

Lutzomyia corossoniensis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermatheca; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

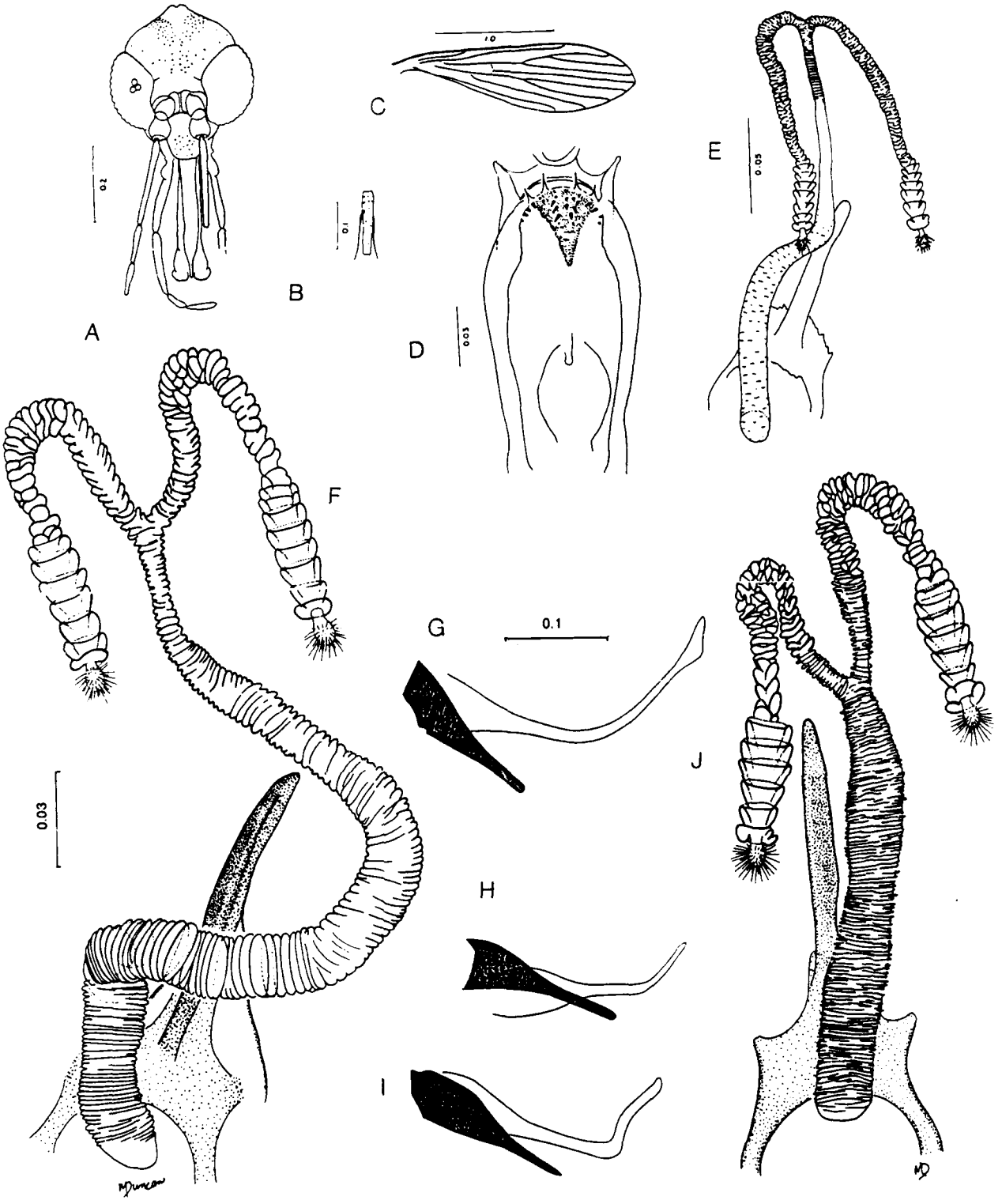



Plate 33-12

Lutzomyia sp. of Tres Esquinas. A. Female head; B. Female flagellomere II; C. Female wing; D. Female cibarium; E. Spermathecae (from Young 1979).

Lutzomyia corossoniensis. G. Paramere & aedeagus (after LePont & Desjeux 1982).

Lutzomyia dorlinsis. H. Paramere & aedeagus (after LePont & Desjeux 1982).

Lutzomyia geniculata I. Paramere & aedeagus (after LePont & Desjeux 1982).

Lutzomyia sp. F & J. Spermathecae, females from Venezuela.

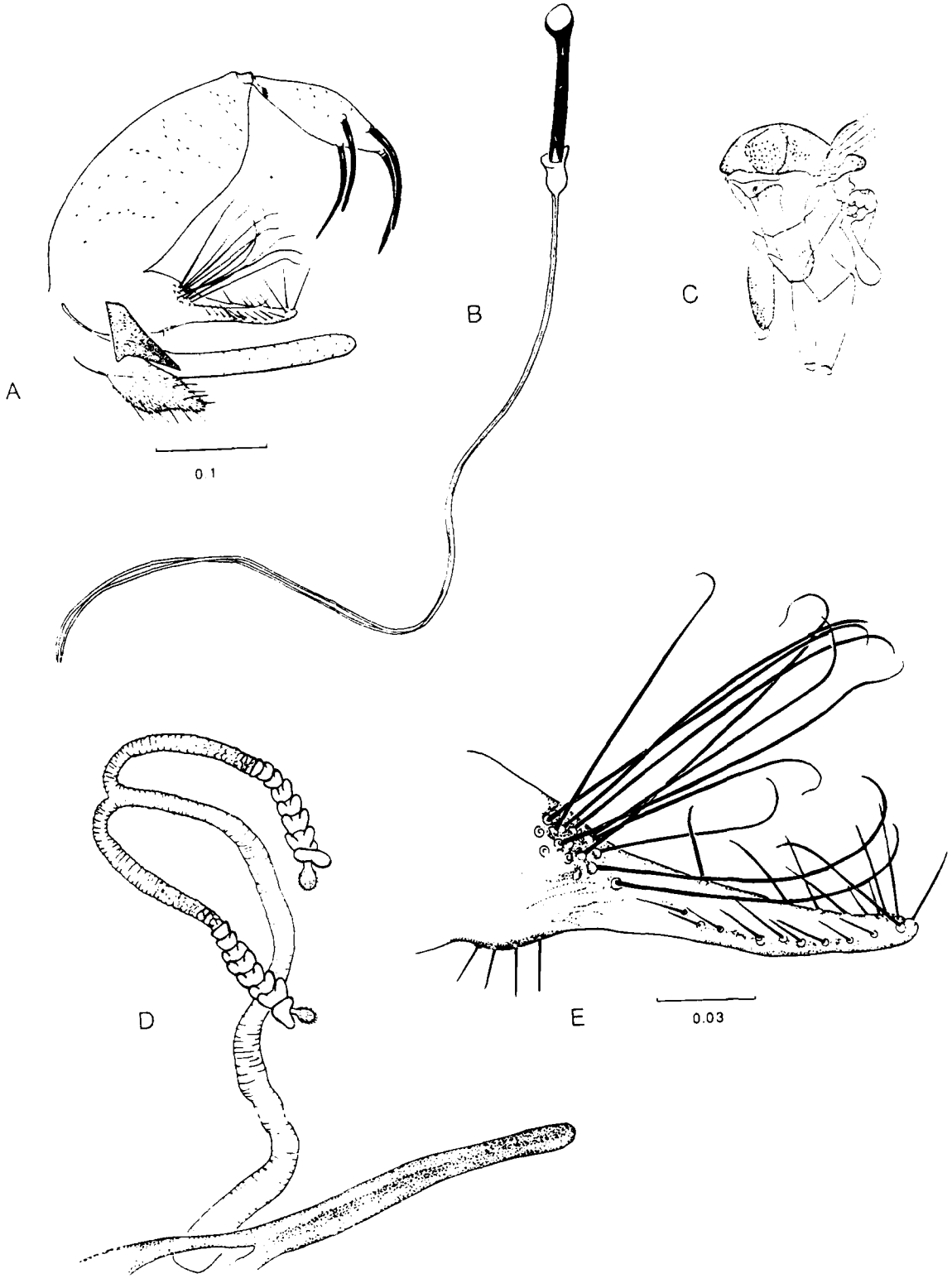



Plate 33-13

Lutzomyia matosi. A. Male terminalia; B. Genital pump & filaments; C. Thorax; D. Spermathecae; E. Paramere.

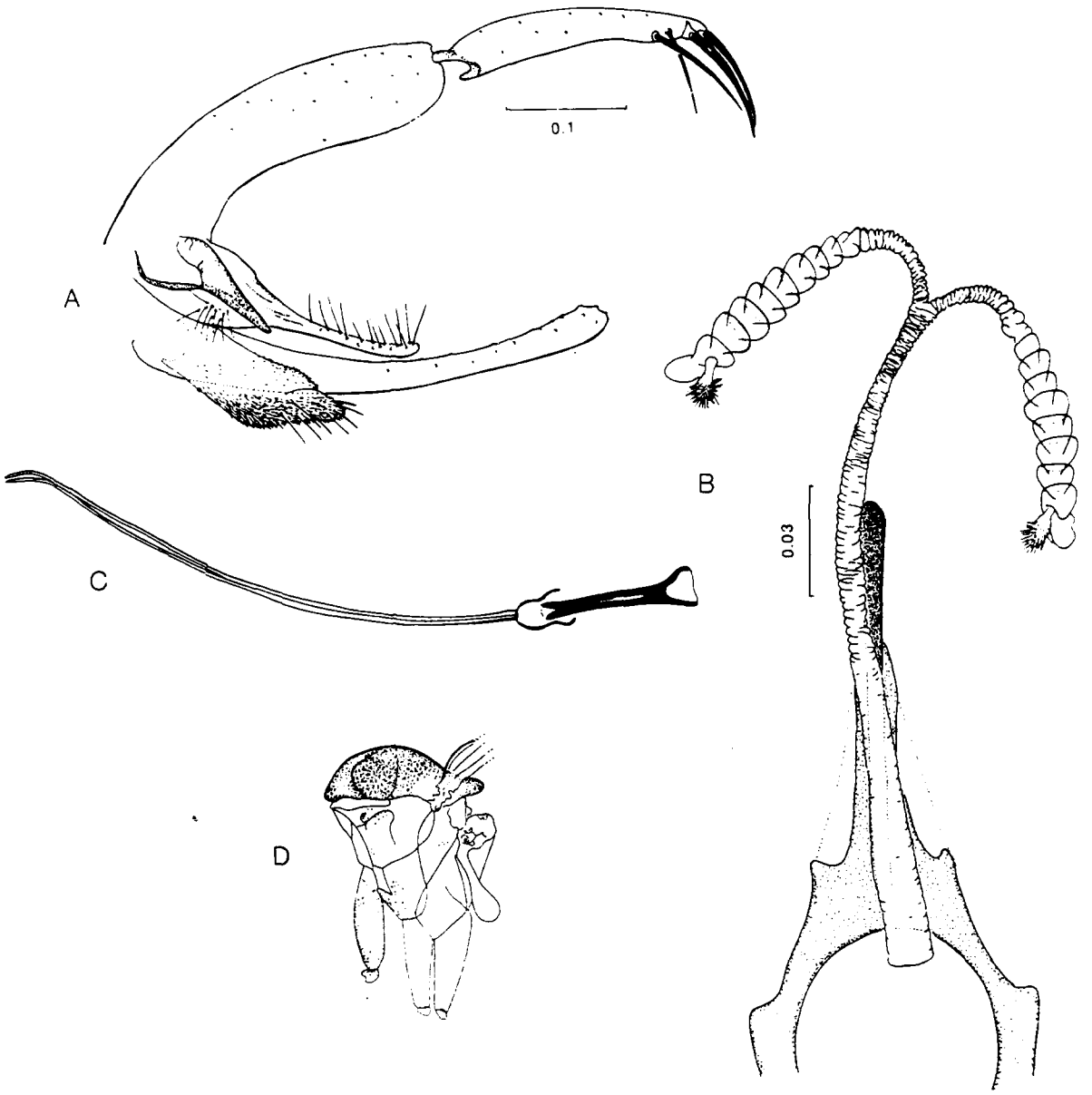



Plate 33-14

Lutzomyia arthuri. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments; D. Thorax.

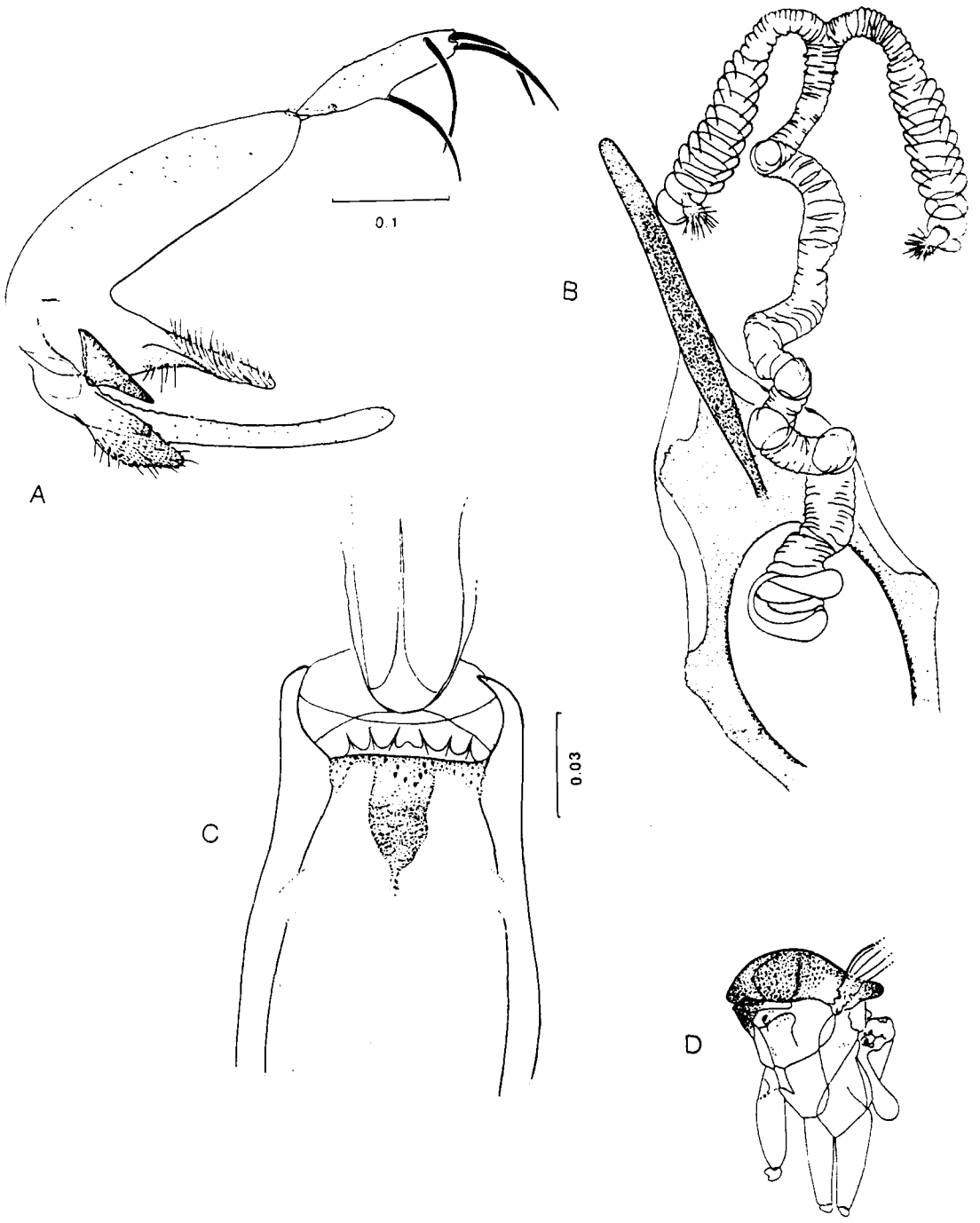



Plate 33-15

Lutzomyia lloydi. A. Male terminalia; B. Spermathecae; C. Female cibarium; D. Thorax.

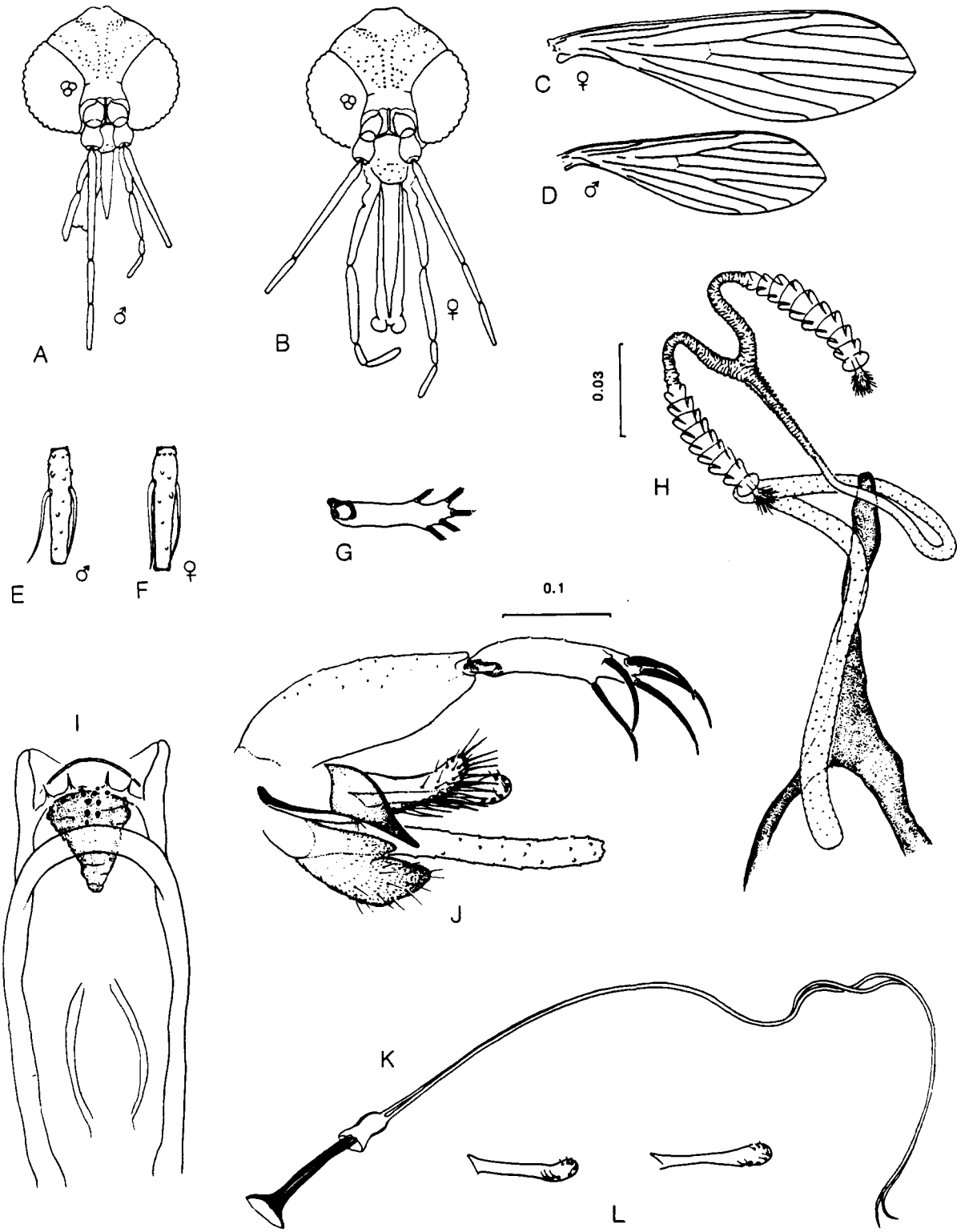



Plate 33-16

Lutzomyia davisi. A. Male head; B. Female head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Style; H. Spermathecae; I. Female cibarium; J. Male terminalia; K. Genital pump & filaments; L. Parameres (figs. from Young & Rogers 1984, same scale as those in Plate 18).

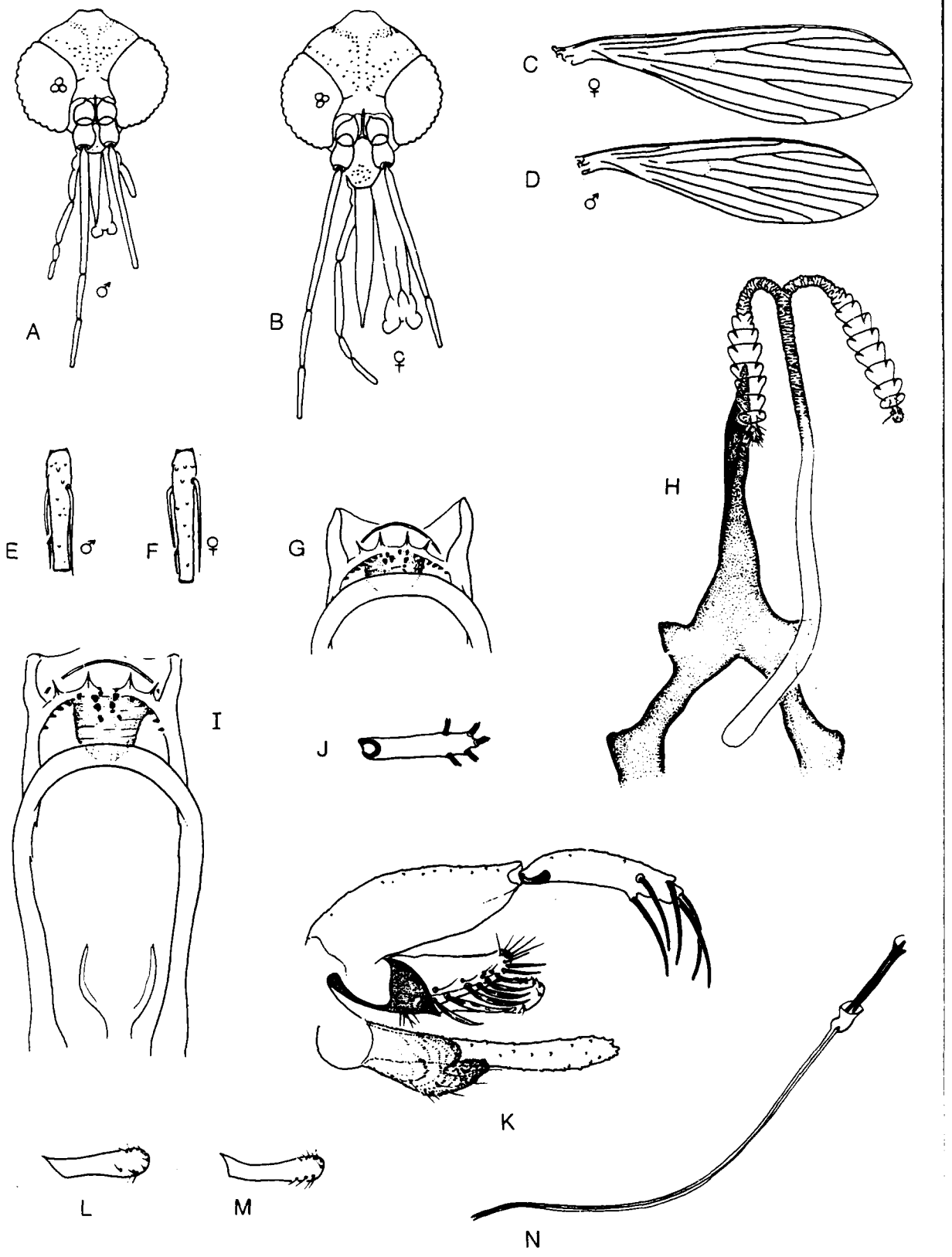



Plate 33-17

Lutzomyia claustrei. A. Male head; B. Female head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Spermathecae; I. Female cibarium; J. Style; K. Male terminalia; L. Paramere; M. Paramere; N. Genital pump & filaments (figs. from Young & Rogers 1984, same scale as those in Plate 18).

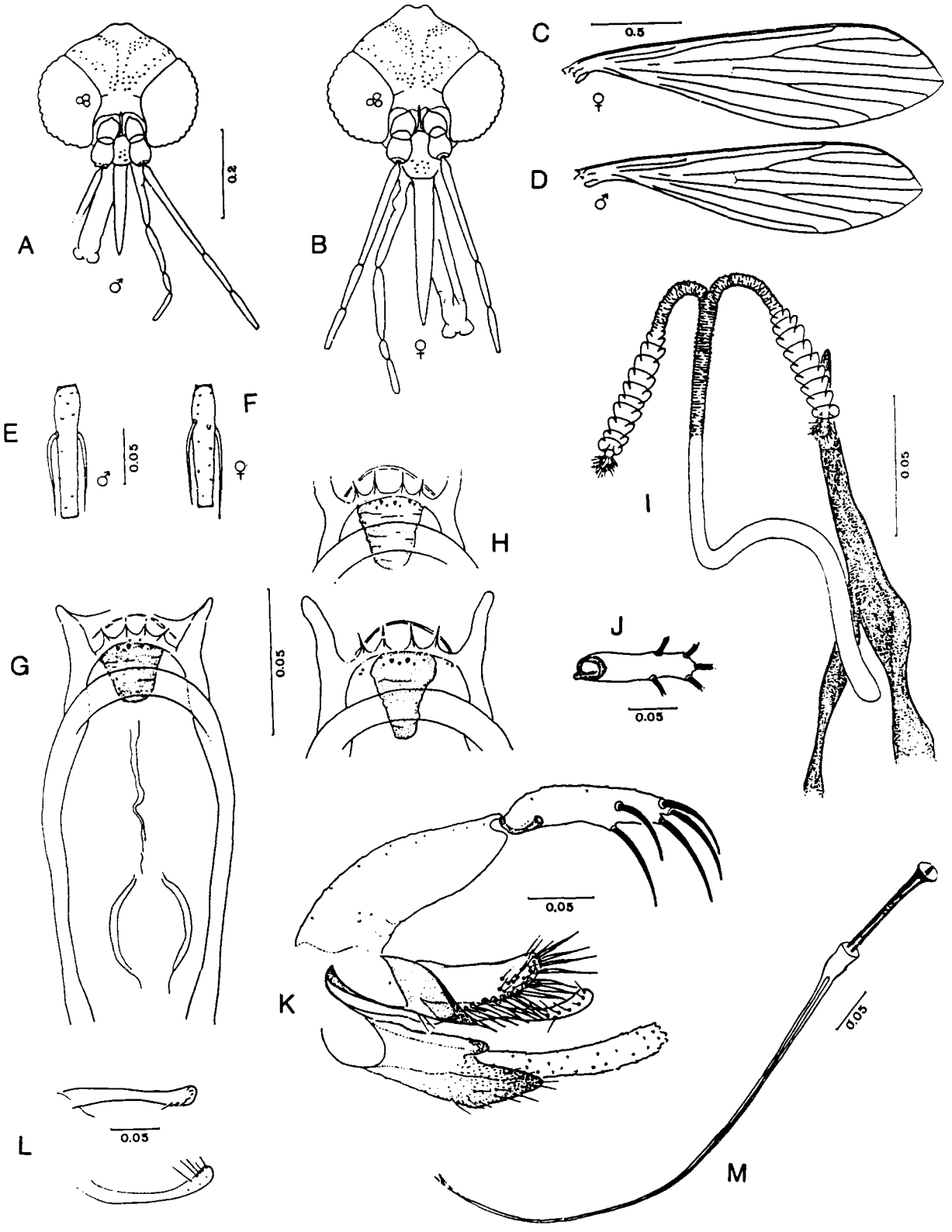



Plate 33-18

Lutzomyia amazonensis. A. Male head; B. Female head; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Female cibaria of other females showing variation; I. Spermathecae; J. Male style; K. Male terminalia; L. Parameres shown at different angles of view; M. Genital pump & filaments (from Young & Rogers 1984).

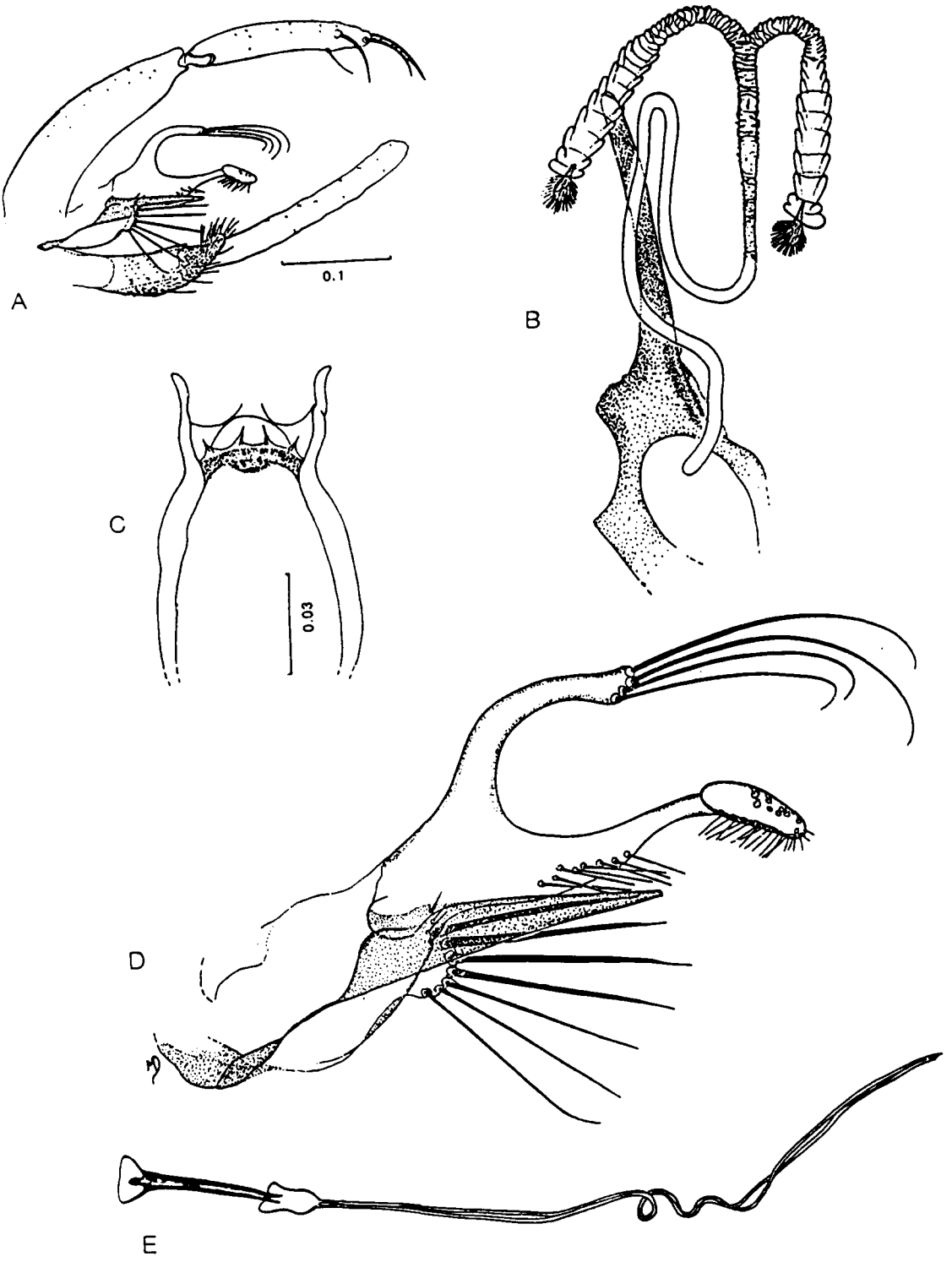



Plate 33-19

Lutzomyia llanosmartinsi. A. Male terminalia, B. Spermathecae, C. Female cibarium, D. Paramere & aedeagus, E. Genital pump & filaments.

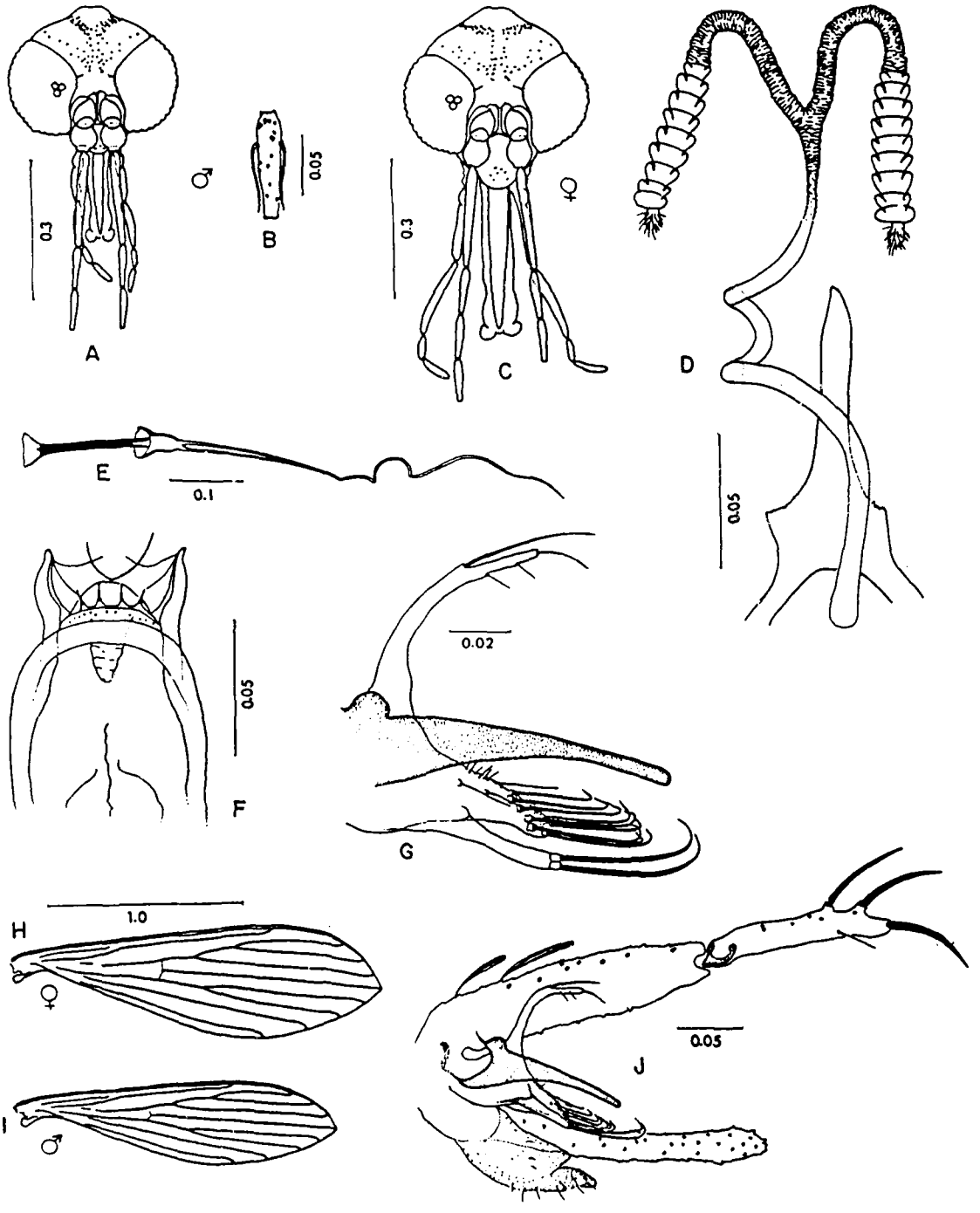



Plate 33-20

Lutzomyia recurva A. Male head; B. Male flagellomere II; C. Female head; D. Spermathecae; E. Genital pump & filaments; F. Female cibarium; G. Aedeagus & paramere; H. Female wing; I. Male wing; J. Male genitalia (from Young 1973).

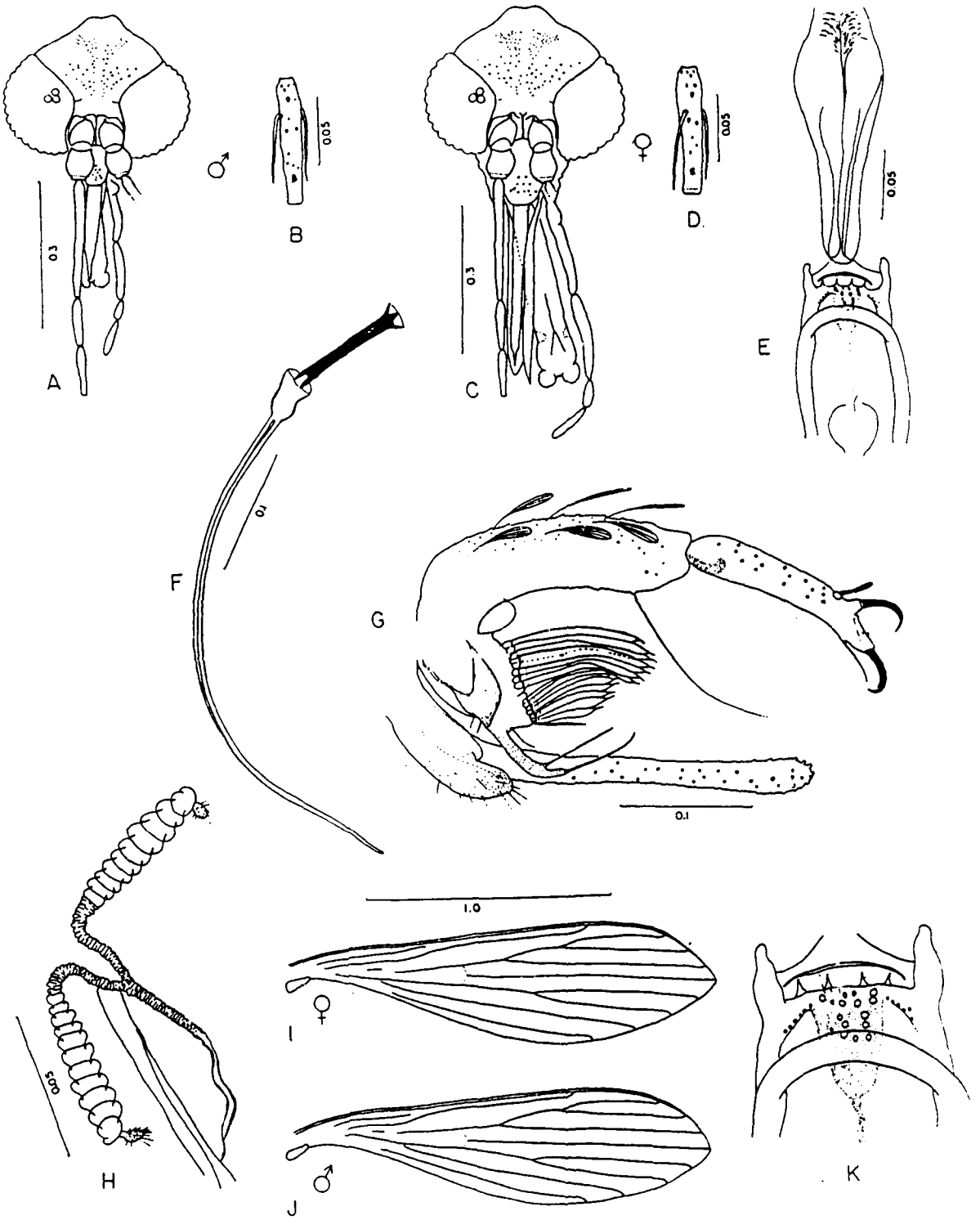



Plate 33-21

Lutzomyia panamensis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

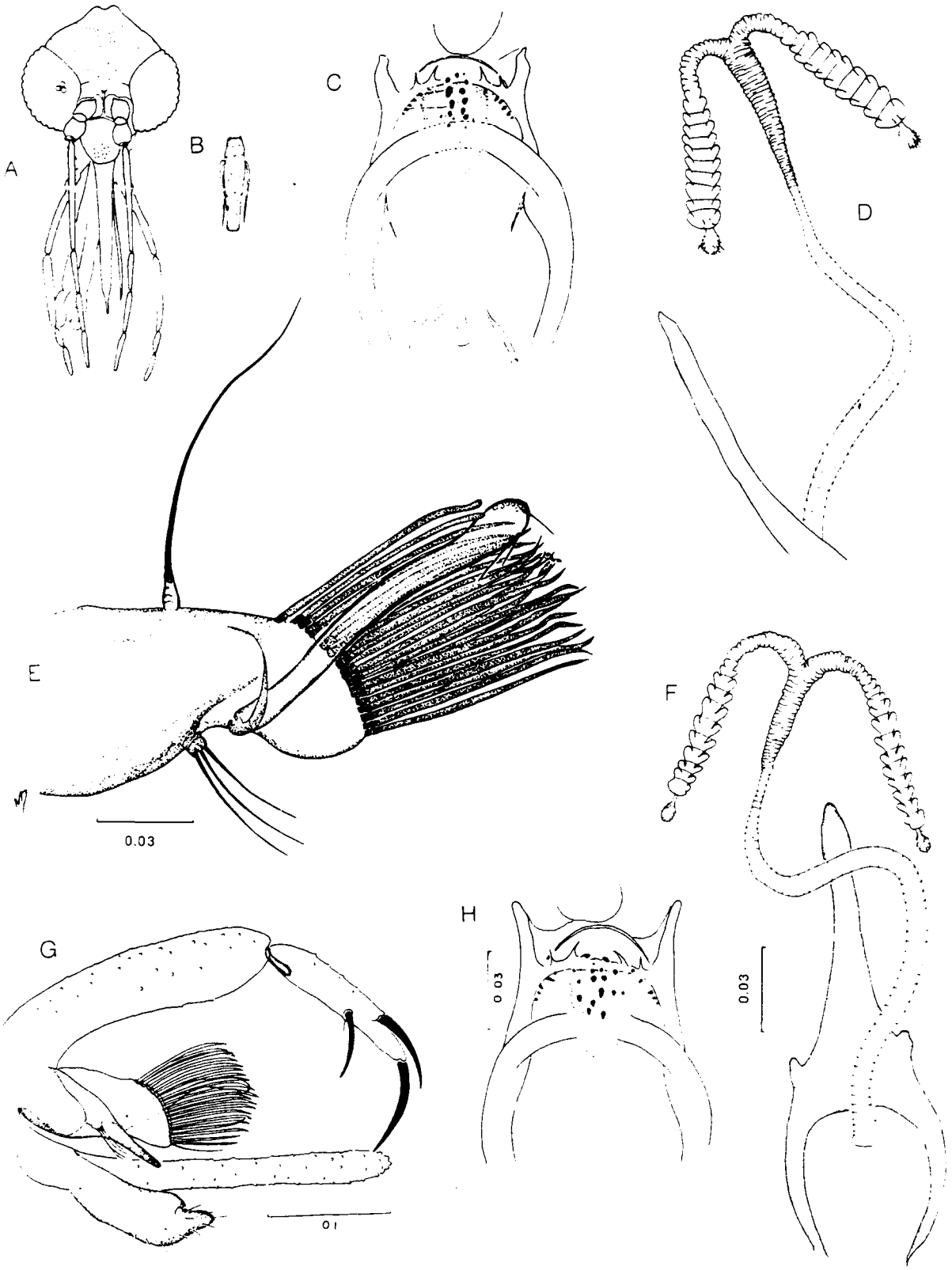



Plate 33-22

Lutzomyia hirsuta nicaraguensis. A. Female head; B. Female flagellomere II; C. Female cibarium; D. Spermathecae; E. Paramere (female figs. from Young 1979).

Lutzomyia hirsuta hirsuta. F. Spermathecae; G. Male terminalia; H. Female cibarium (from Young 1979).

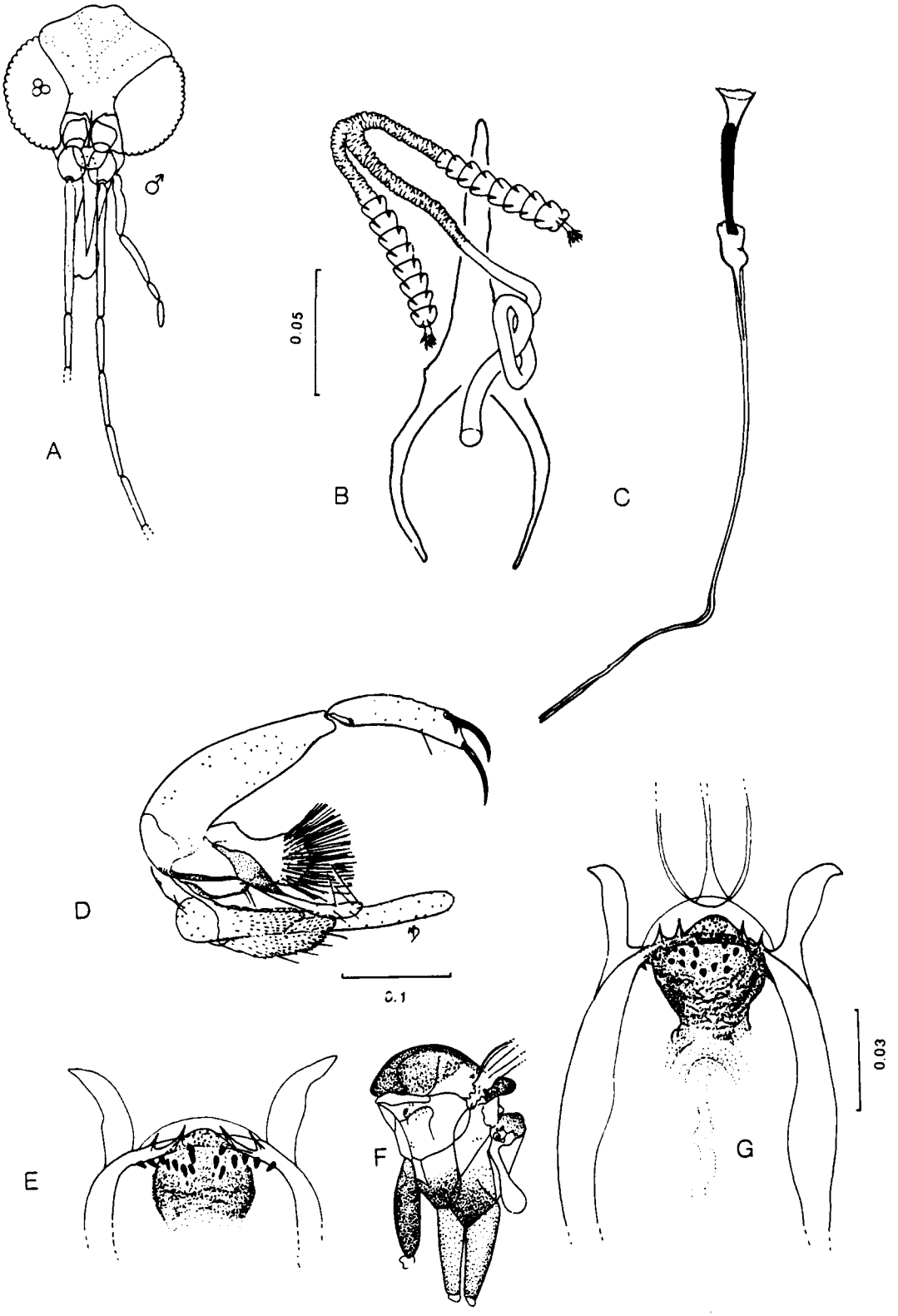



Plate 33-23

Lutzomyia paraensis. A. Male head; B. Spermathecae; C. Genital pump & filaments; D. Male terminalia; E. Female cibarium showing inwardly slanted teeth; F. Thorax; G. Female cibarium with straight horizontal teeth (less common).

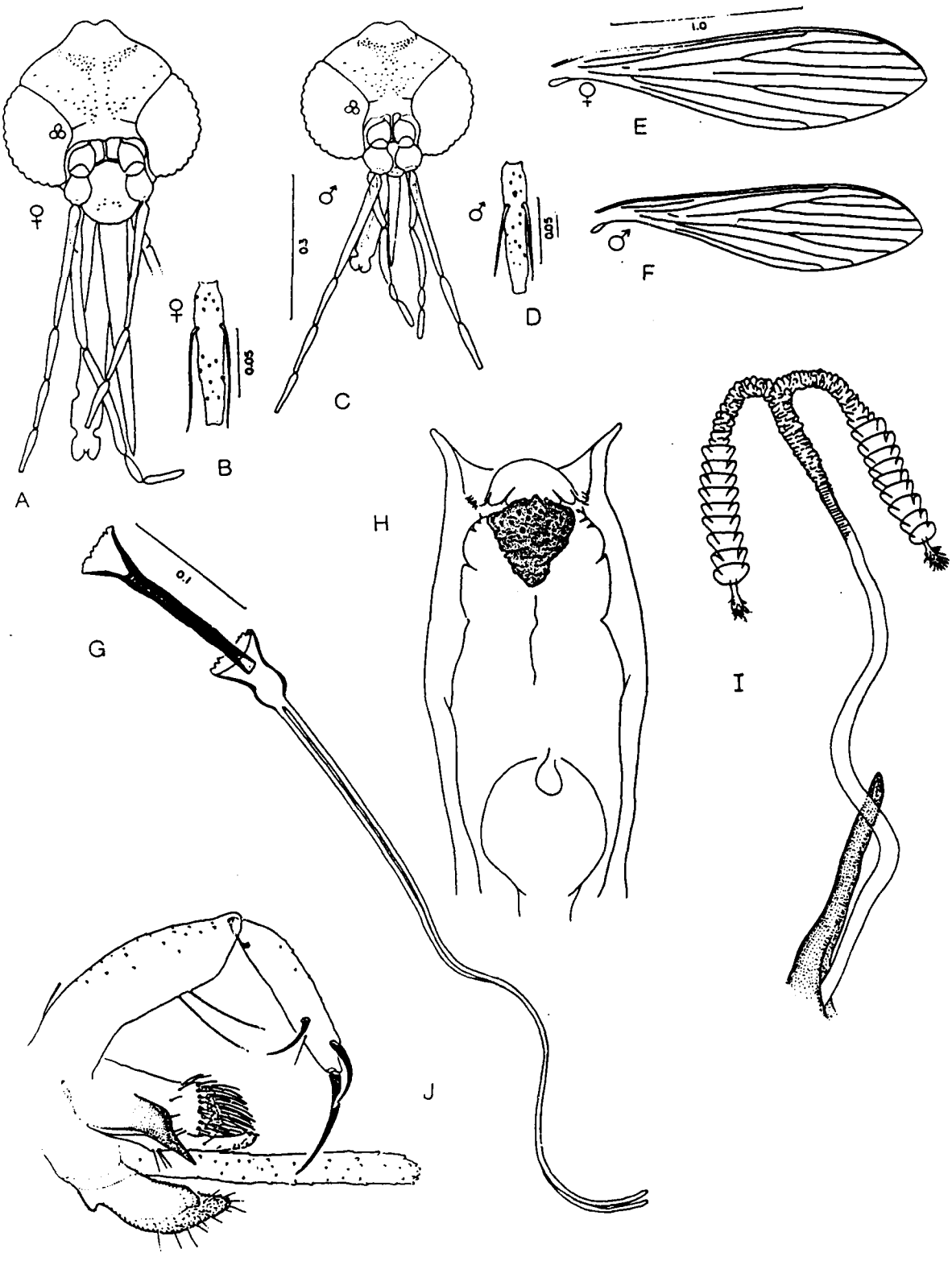



Plate 33-24

Lutzomyia ayrozai. A. Female head; B. Female flagellomere II; C. Male head; D. Female flagellomere II; E. Female wing; F. Male wing; G. Genital pump & filaments; H. Female cibarium; I. Spermathecae; J. Male terminalia (from Young 1979).

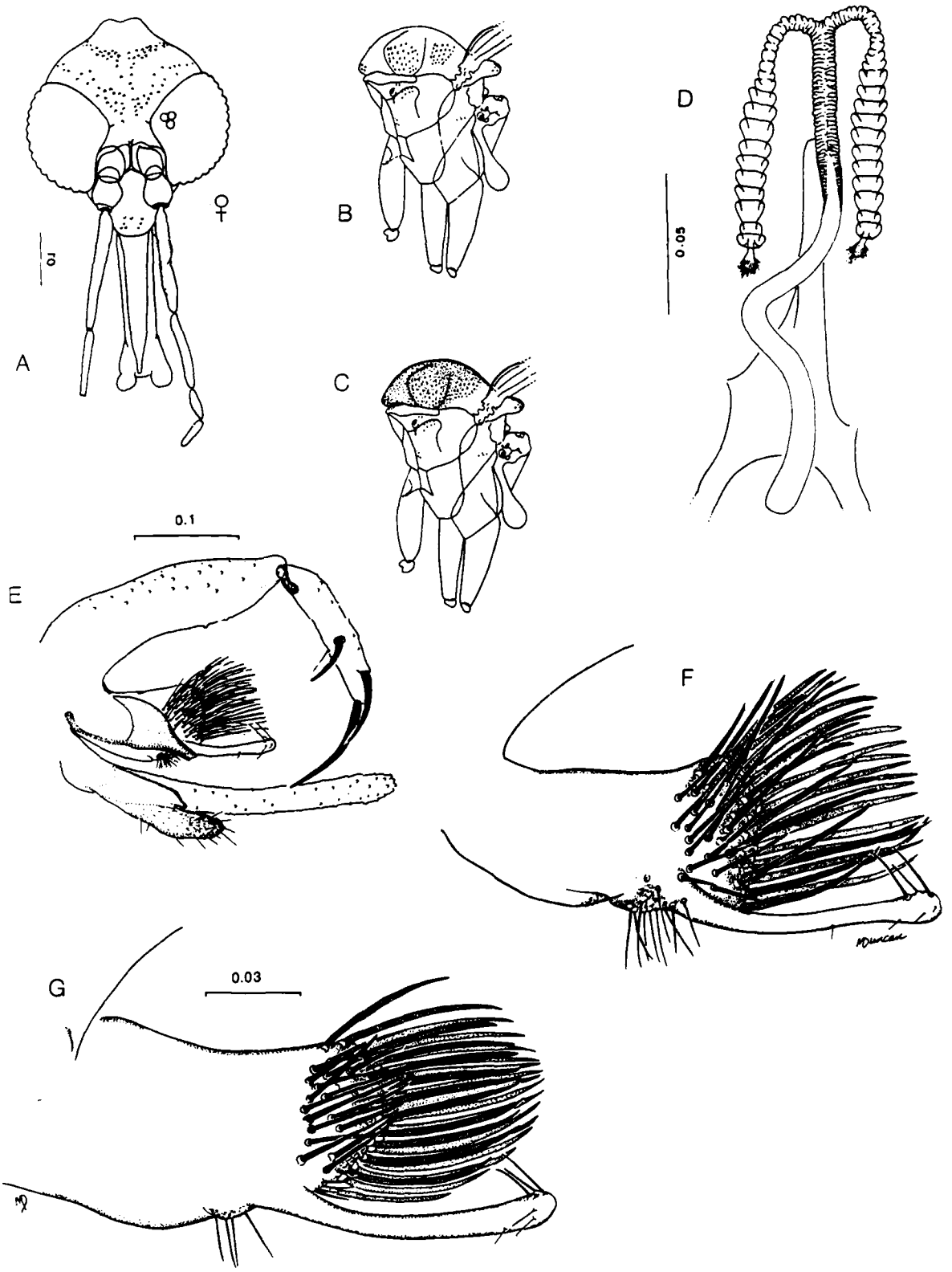



Plate 33-25

Lutzomyia carrerai carrerai. A. Female head; B. Thorax; D. Spermathecae; E. Male terminalia; F. Paramere (all figs. except B & F from Young 1979).

Lutzomyia yucumensis. C. Thorax; G. Paramere.

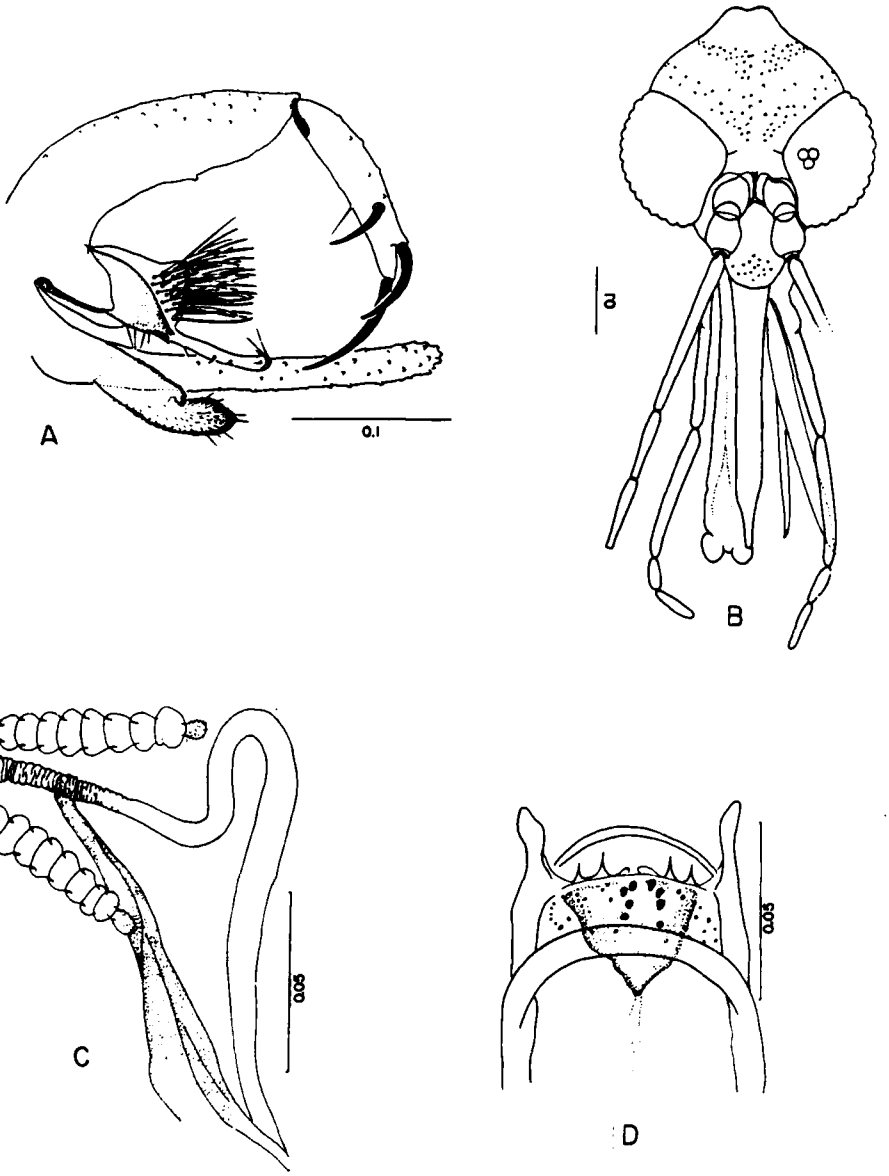



Plate 33-26

Lutzomyia carrerai thula. A. Male terminalia; B. Female head; C. Spermathecae; D. Female cibarium.

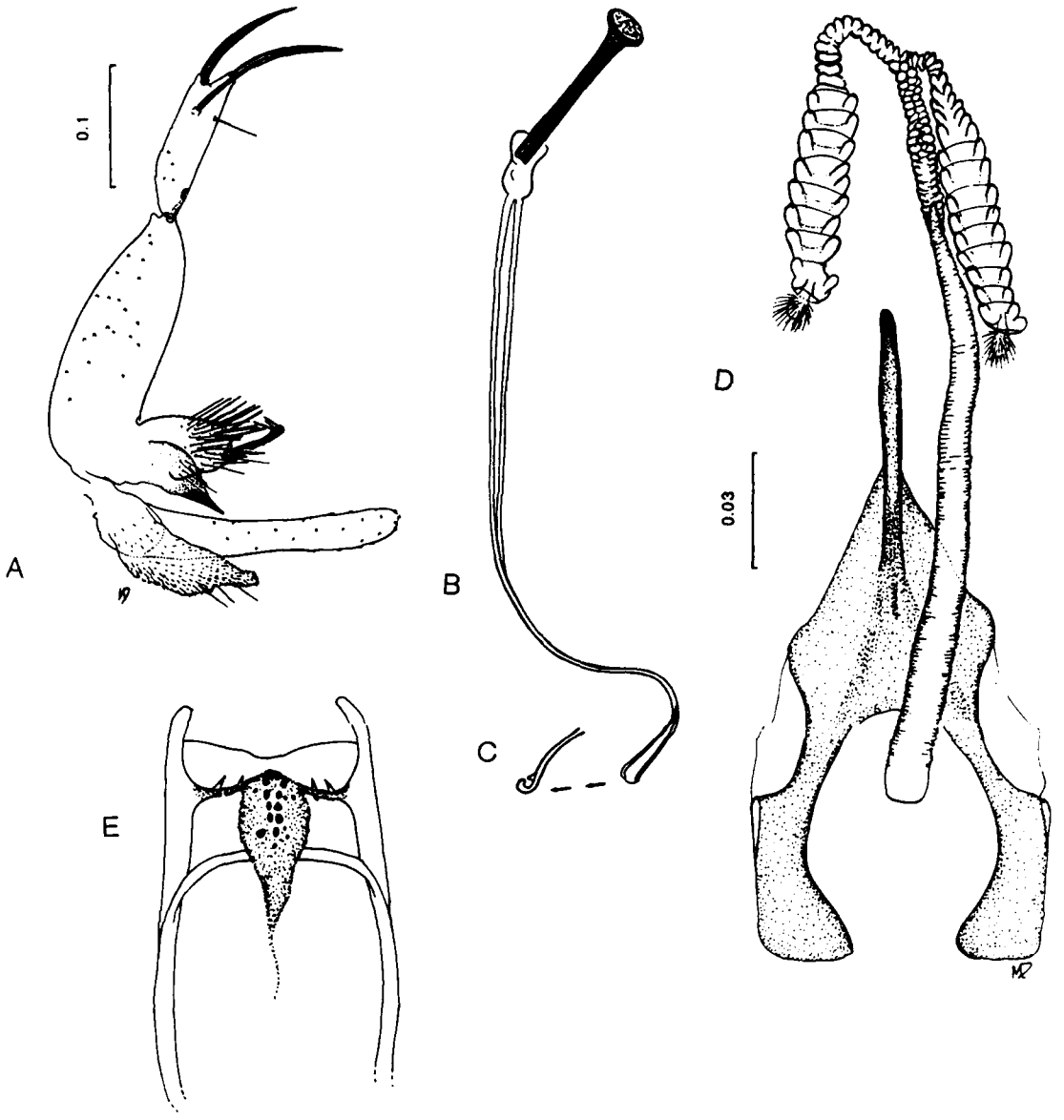



Plate 33-27

Lutzomyia fairchildi. A. Male terminalia; B. Genital pump & filaments; Tip of genital filament; D. Spermathecae; E. Female cibarium (fig. C from Barretto 1966).

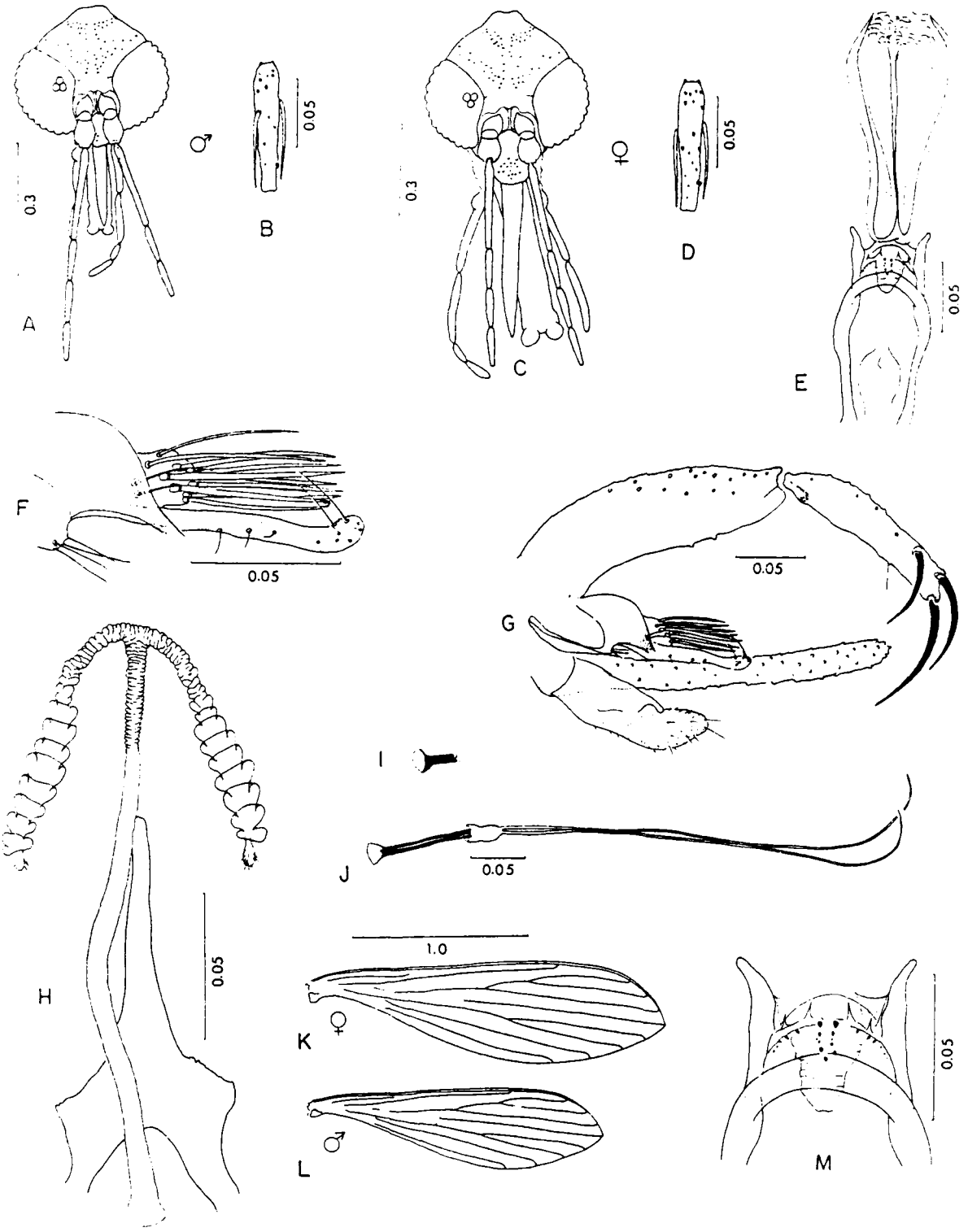
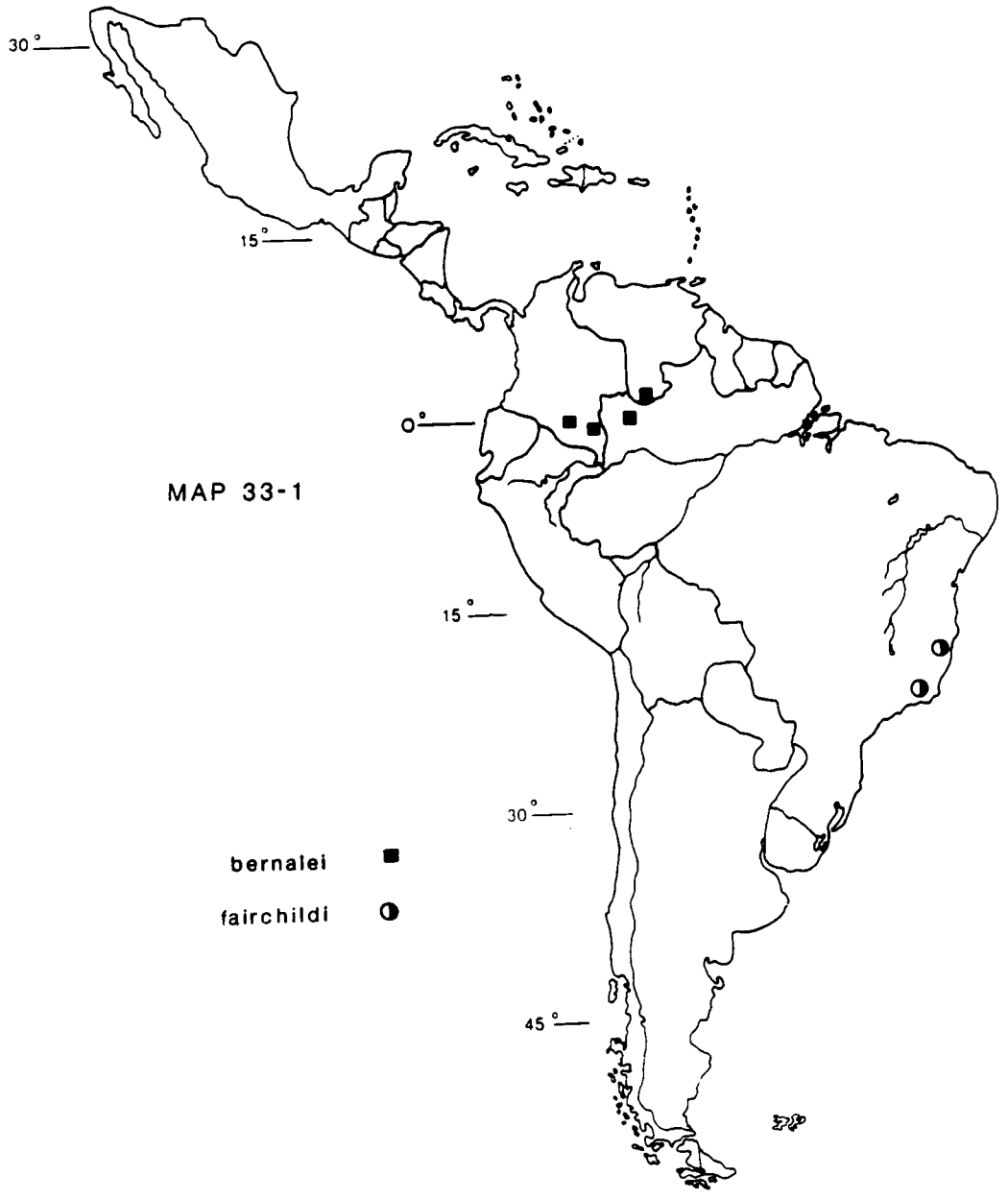
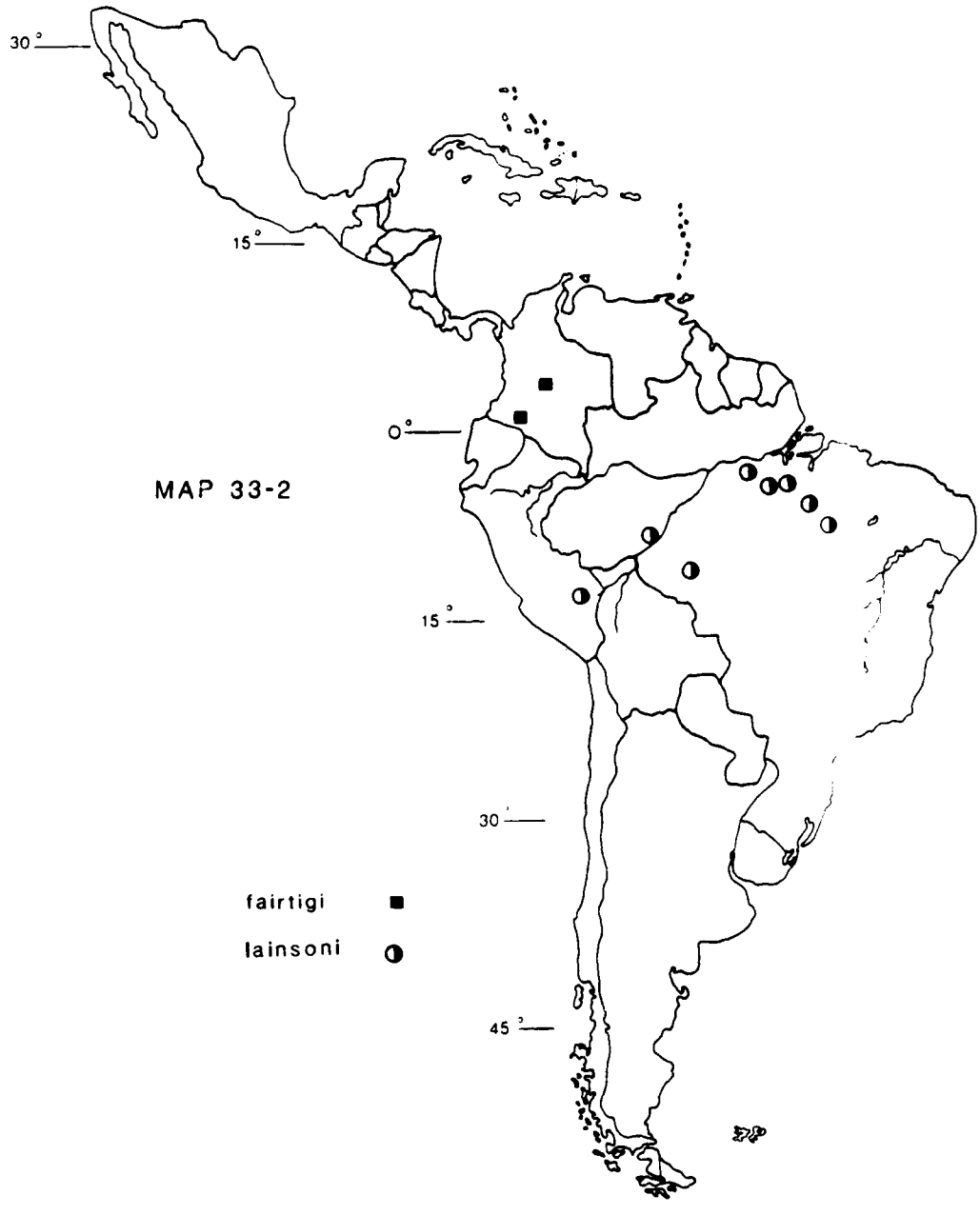



Plate 33-28

Lutzomyia nocticola. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Paramere; G. Male terminalia; H. Spermathecae; I. Base of genital pump; J. Genital pump & filaments; K. Female wing; L. Male wing; M. Female cibarium.




MAP 33-1



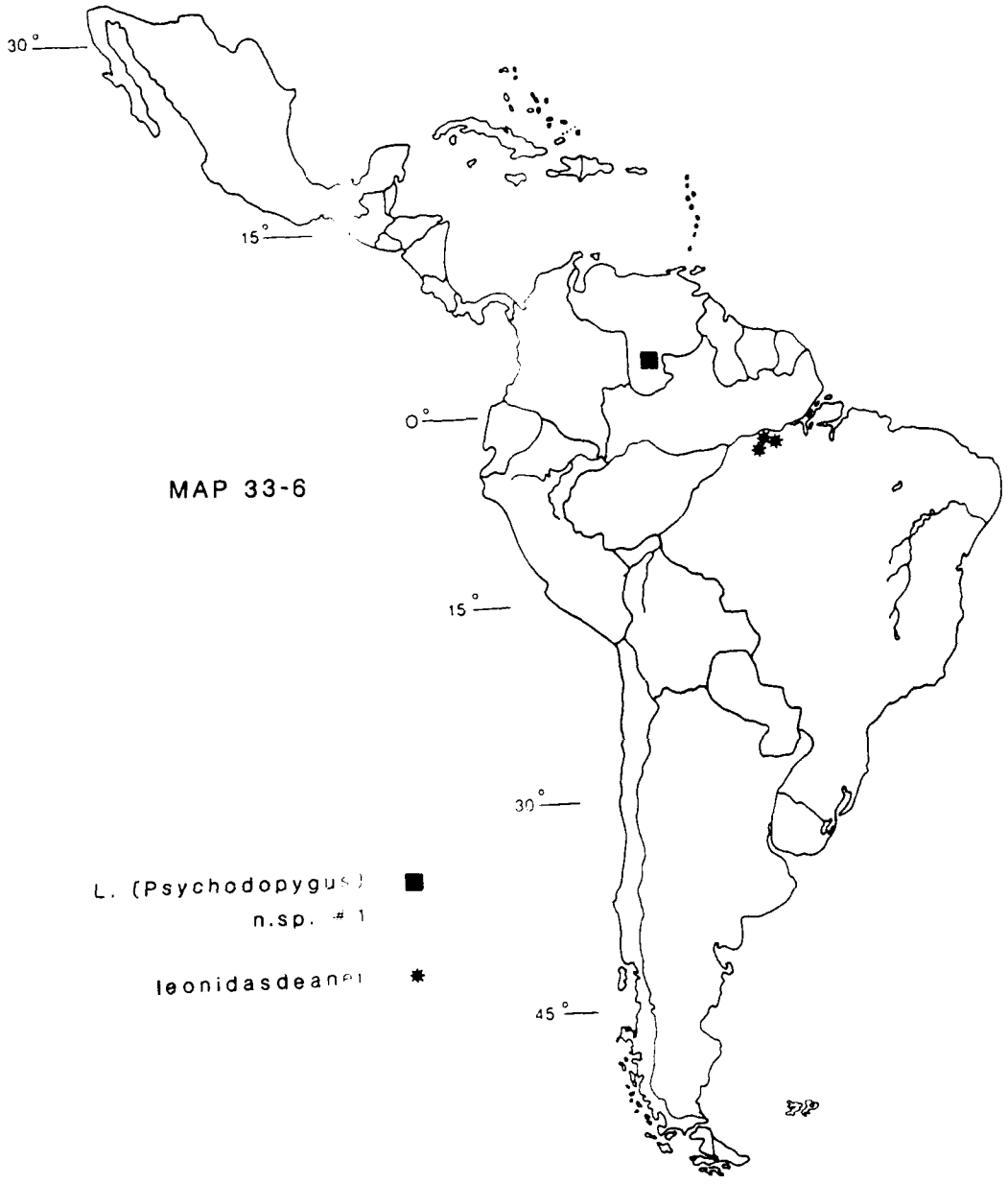

MAP 33-2

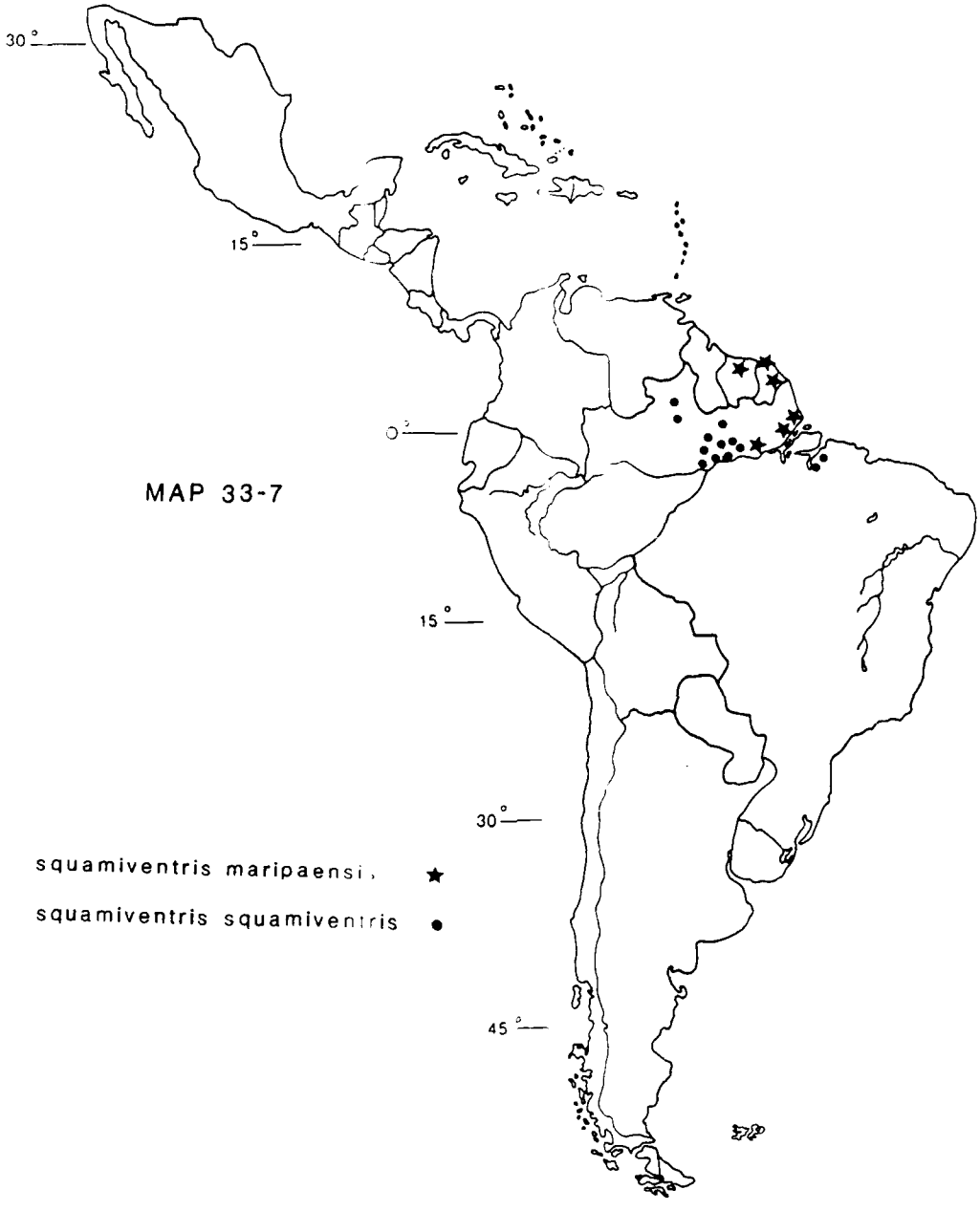

30°
15°
0°
15°
30°
45°
MAP 33-3
wellcomei
yucumensis


30°
15°
0°
15°
30°
45°
MAP 33-4
complexa




MAP 33-5

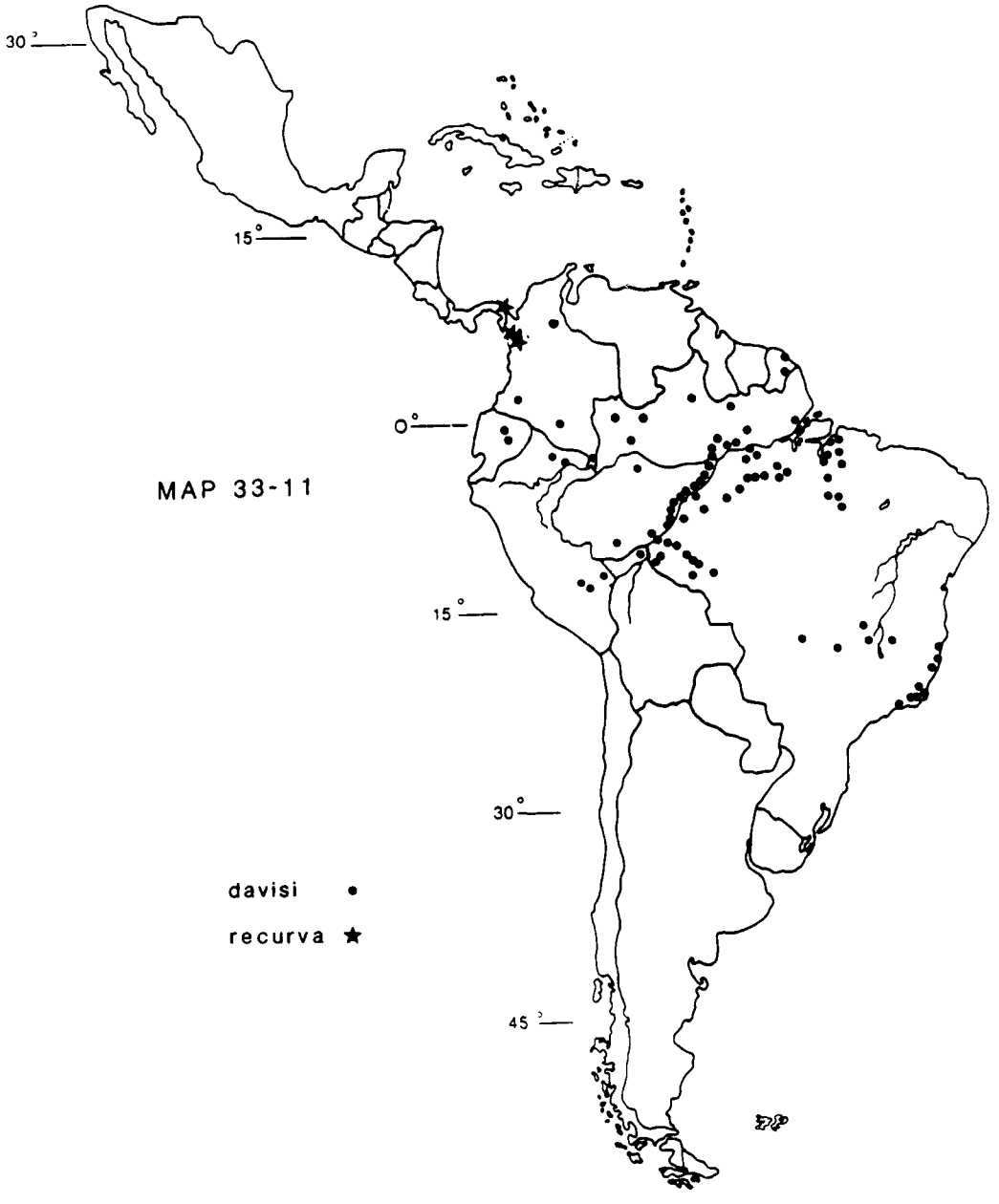

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0°
15°
30°
45°
MAP 33-6
L. (Psychodopygus)
n.sp. # 1
leonidasdeanei

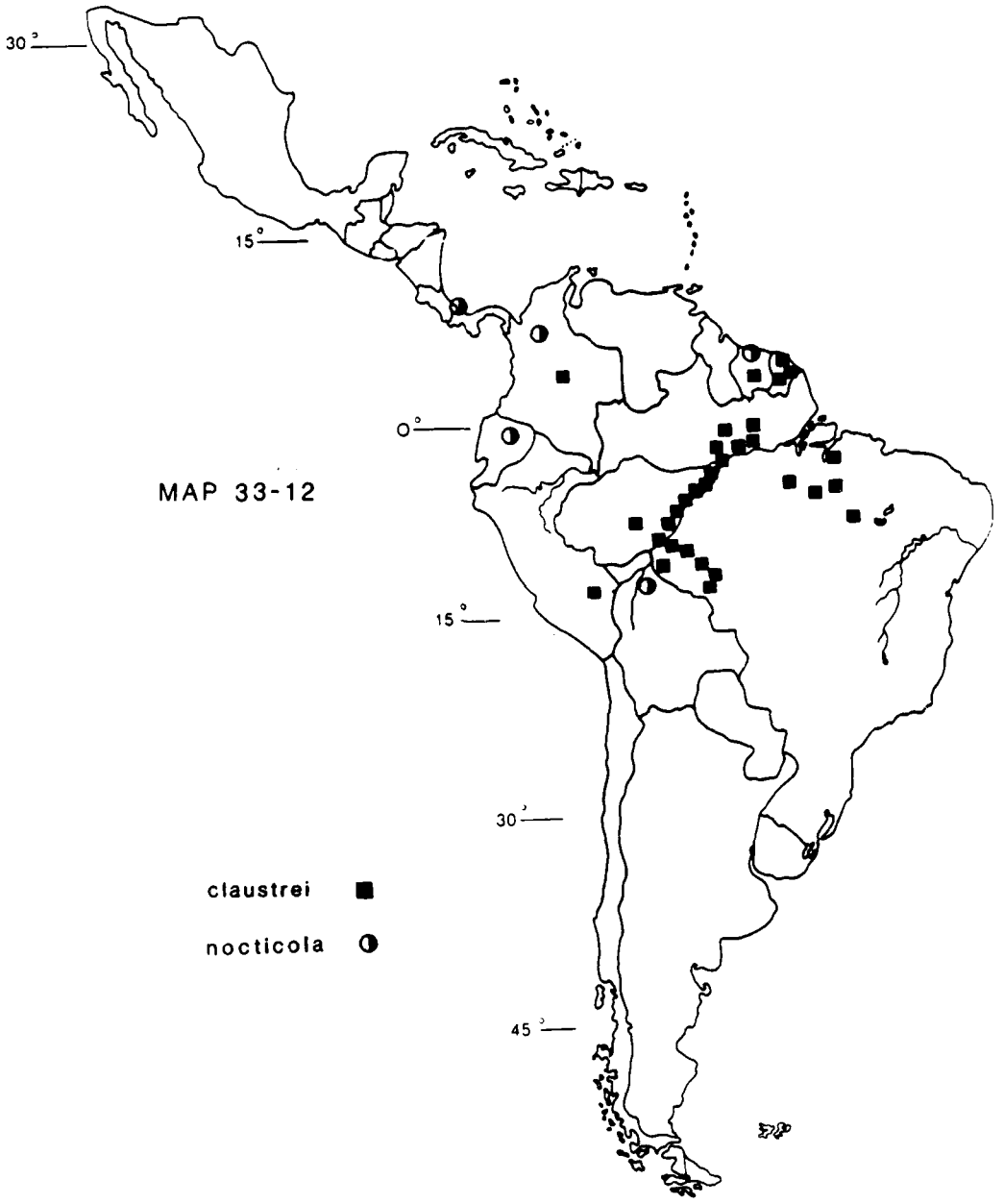

30°
15°
0°
15°
30°
45°
MAP 33-7
squamiventris maripaensi
squamiventris squamiventris


30°
15°
0°
15°
30°
45°
MAP 33-8
bispinosa
matosi


30°
15°
0°
15°
30°
45°
?
MAP 33-9
corossoniensis

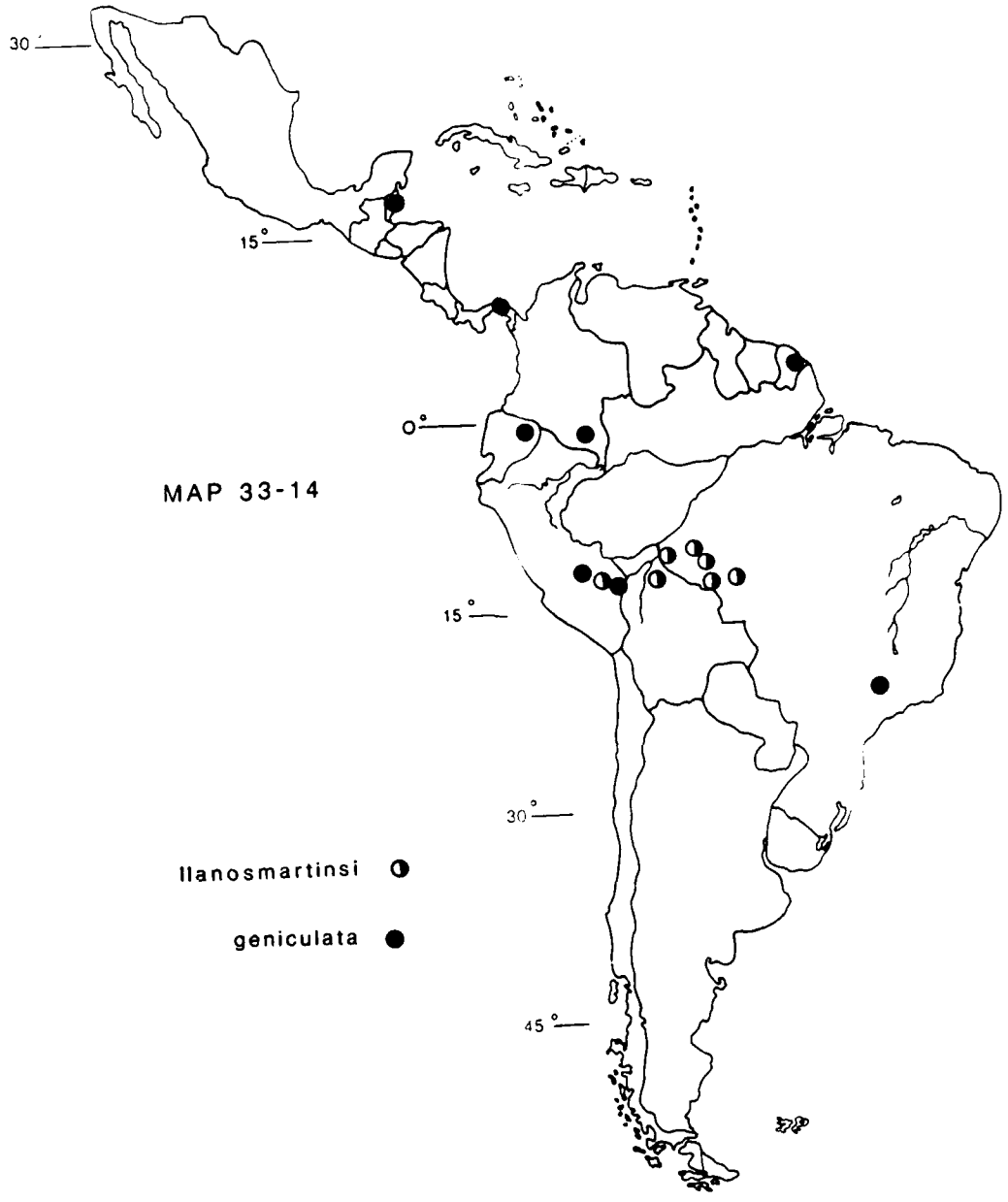

30°
15°
0°
15°
30°
45°
MAP 33-10
L. sp. of Tres Esquinas
guyanensis
lloydi

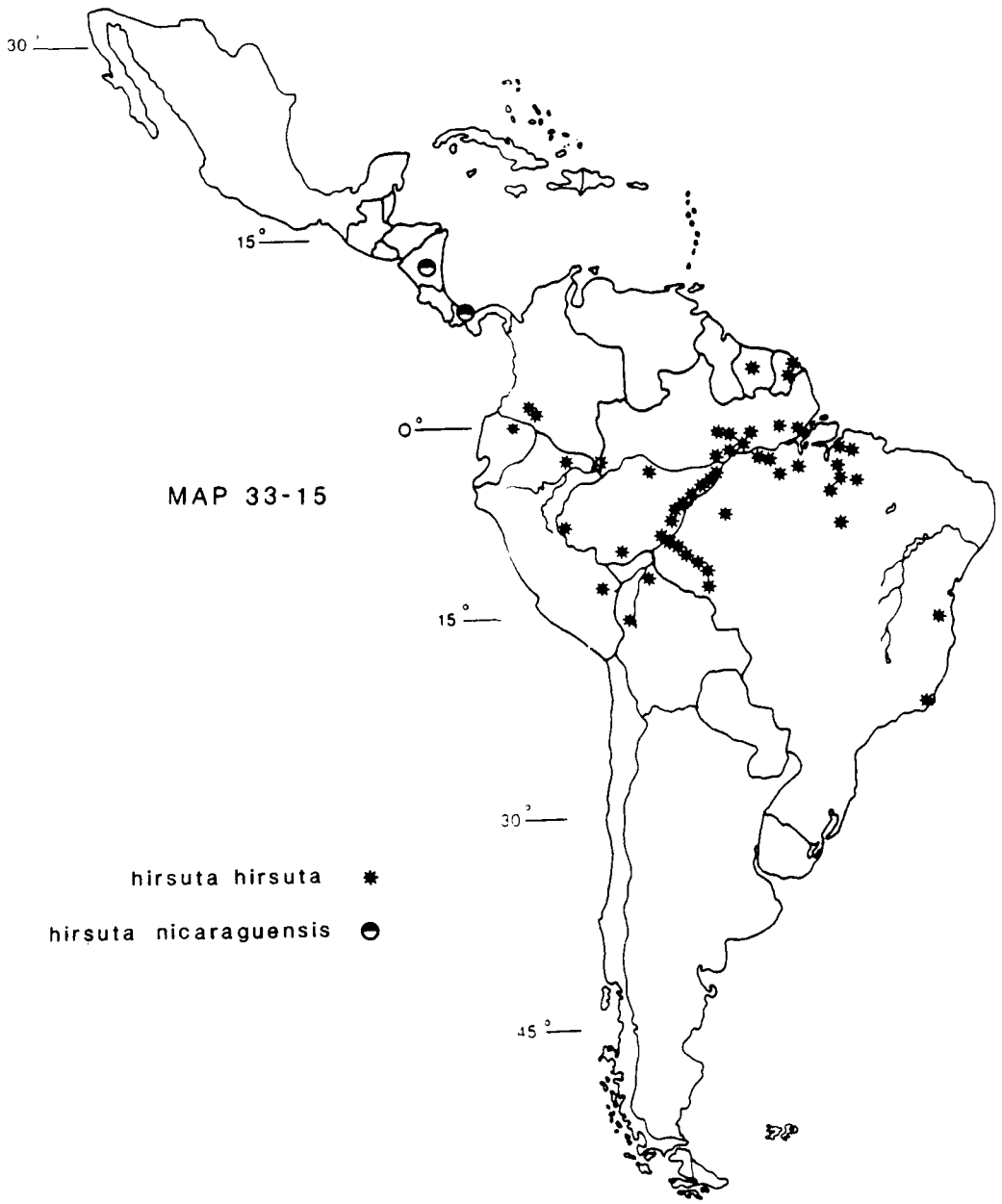

30°
15°
0°
15°
30°
45°
MAP 33-11
davisi
recurva

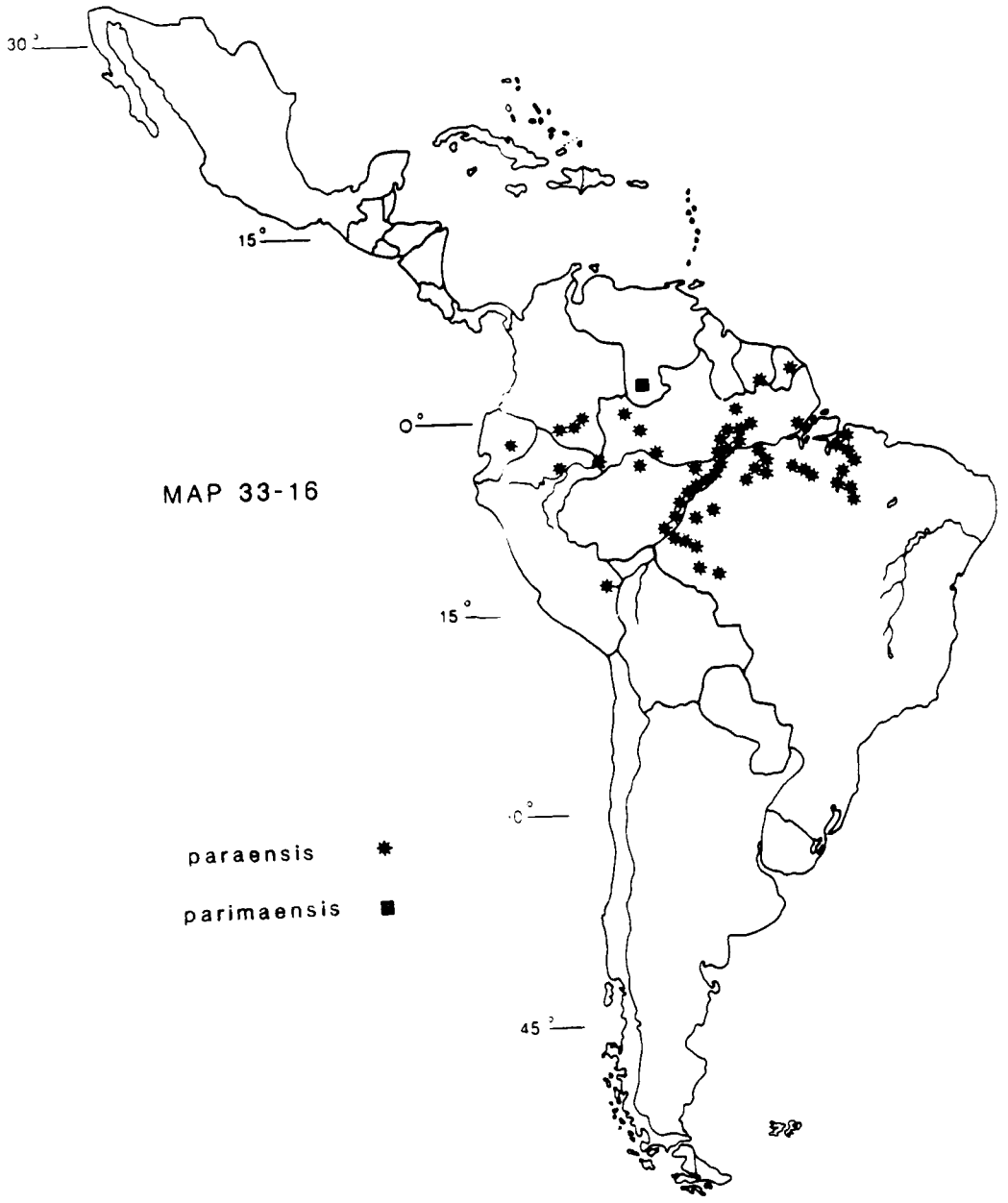

30°
15°
0°
15°
30°
45°
MAP 33-12
claustrei
nocticola




MAP 33-13


30°
15°
0°
15°
30°
45°
MAP 33-14
llanosmartinsi
geniculata

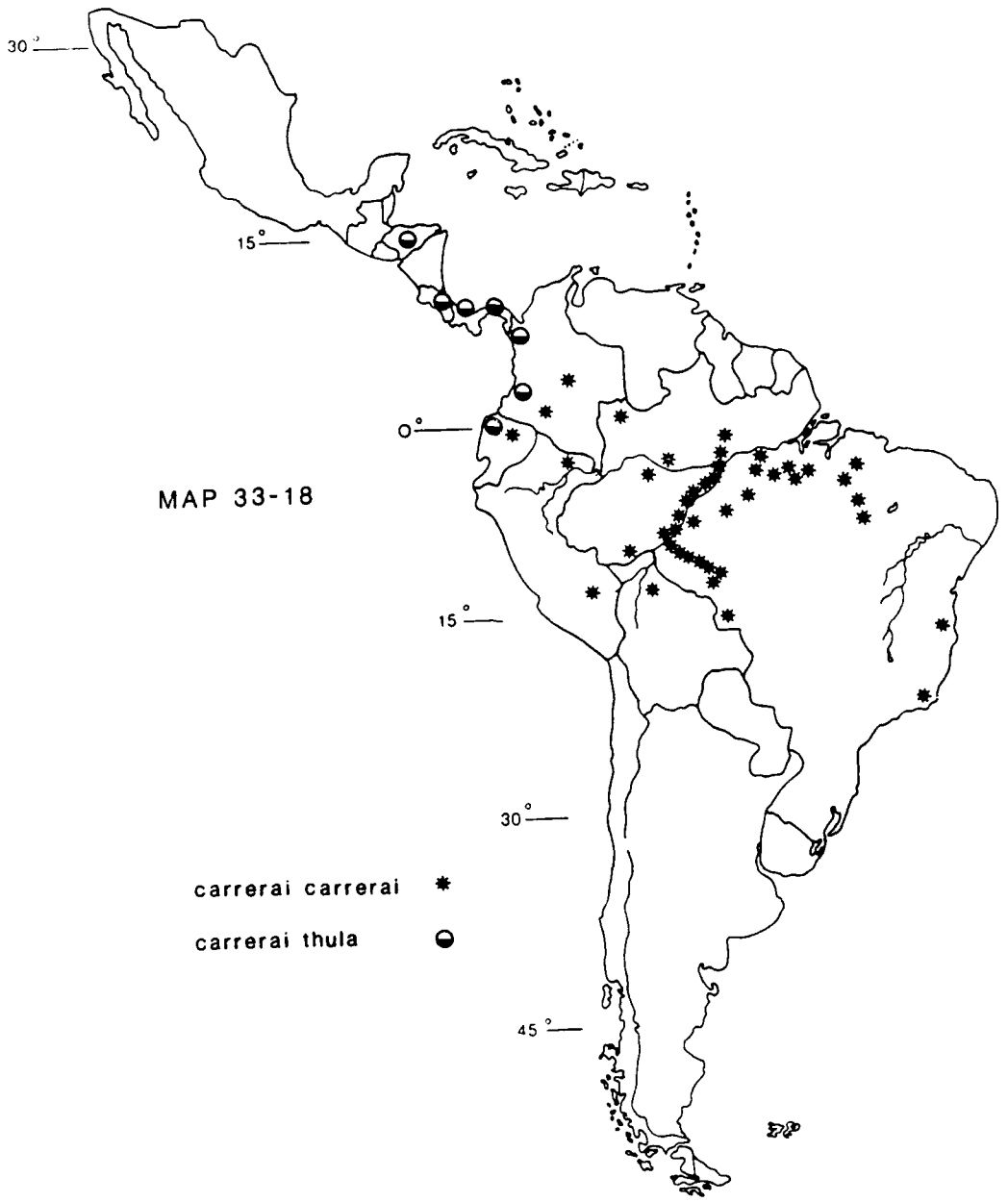

30°
15°
0°
15°
30°
45°
MAP 33-15
hirsuta hirsuta
hirsuta nicaraguensis


30°
15°
0°
15°
0°
45°
MAP 33-16
paraensis
parimaensis




MAP 33-17

ayrozai ■




MAP 33-18

## 34. Lutzomyia Subgenus Micropygomyia Barretto

Lutzomyia subgenus Micropygomyia Barretto 1962: 95 (type species: Phlebotomus cayennensis Floch & Abonnenc by orig. designation). Forattini 1971a: 100; 1973: 335 (in part). Martins et al. 1978: 60 (in part).

Lutzomyia species group cayennensis Theodor 1965: 186. Lewis et al. 1977: 325.

Lutzomyia subgenus Coromyia: Forattini 1971a: 101; 1973: 273 (in part).

Lutzomyia subgenus Trichopygomyia: Forattini 1971a: 101; 1973: 292 (in part).

Lutzomyia species group atroclavata: Martins et al. 1978: 129 (in part).

Identification. Coloration pale to dark. Antennal ascoids simple, those on flagellomere II not reaching end of segment. Palpomere 5 longer than palp. 3. ♀ cibarium with 4 to 30 horizontal teeth; arch usually conspicuous only at sides; pigment patch visible. Pharynx armed with spines or unarmed. Spermathecae variable; common duct always shorter than individual ducts. ♂ genitalia. Coxite with or without persistent setae. Style with 4-5 spines; no subterminal seta. Paramere simple. Genital filament tips simple or expanded.

Several species in this subgenus are known only from single specimens; others have not been adequately described and therefore the keys must be used with caution.

We divide the subgenus into 4 complexes -- cayennensis, atroclavata, chiapaensis and minasensis -- by character states given in the keys.

Medical Importance. Unknown; the females are not anthropophilic; some species feed on lizards.

Key to the males of the subgenus Micropygomyia*

1. Style with 5 spines (chiapanensis complex). ..... 2
   Style with 4 spines. ..... 3

2. Genital filament tips inflated. Coxite with few ( <5) or no persistent setae near middle of structure. Paramere as shown. ..... L. durani (Pl. 34-1)
   Genital filament tips not inflated. Coxite with basal group of 5-7 setae & median group of 10+ setae. Paramere otherwise. ..... L. chiapanensis (Pl. 34-2)

3. Coxite with group of persistent setae (atroclavata complex). ..... 4

---

* The males of L. ctenidophora, L. wirthi & L. farilli are unknown.

Coxite without persistent setae. ..... 5

4. Coxite with 4-5 persistent setae, one or more modified (foliceaous). ..... L. atroclavata (Pl. 34-3)

Coxite with 7-11 simple persistent setae.... L. venezuelensis (Pl. 34-3)

5. Paramere as shown, with 2 long dorsal setae, much longer than others, near apex. Antennal ascoids nearly reaching ends of their respective flagellomere. ..... L. quadrispinosa (Pl. 34-4)

Paramere otherwise, without 2 long dorsal setae as above. Antennal flagellomeres much shorter. ..... 6

6. Genital filaments longer than 3X genital pump length. ..... 7

Genital filaments 3X length of genital pump or shorter. ..... 8

7. Thorax with scutum, proepimeron & katepisternum heavily pigmented, nearly black. Labrum & flagellomere I subequal in length. Aedeagus with acute tip. ..... L. yencanensis (Pl. 34-5)

Thorax with pale scutum, proepimeron & katepisternum. Labrum shorter than flagellomere I. Aedeagus with rounded, blunt tip. ..... L. lewisi (Pl. 34-6)

8. Labrum longer than 0.22 mm; subequal in length to palpomere 5 (minasensis complex). ..... 9

Labrum shorter than 0.20 mm; much shorter than palpomere 5. ..... 10

9. Paramere upturned. Style with proximal spine inserted at middle of structure. ..... L. oliveirai (Pl. 34-7)

Paramere not upturned. Style with proximal spine inserted beyond middle of structure. ..... L. minasensis (Pl. 34-7)

10. Flagellomere I subequal to, or longer than, combined length of labrum & clypeus. Profemur longer than hind femur. ..... L. duppyorum (Pl. 34-8)

Flagellomere I shorter than combined length of labrum & clypeus. Profemur shorter than hind femur. ..... 11

11. Genital filament tips expanded as shown. ..... L. schreiberi (Pl. 34-8)

Genital filament tips not expanded. ..... 12

12. Profemur longer than protibia. Thorax with heavily pigmented pleura, as dark as scutum. ..... L. micropyga (Pl. 34-9)

Profemur shorter than protibia: Thorax with pale pleura or, if pigmented, not as dark as scutum. .....

..... L. cayennensis subspecies (Pl. 34-11)

L. cubensis (Pl. 34-14)

Lutzomyia (Micropygomyia) n.sp. #1 (Pl. 34-15)

? L. hardisoni

## Key to the Females of the Subgenus Micropygomyia*

1. Pharynx armed with conspicuous spines at posterior end. ..... 2

Pharynx without conspicuous spines. ..... 17

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*The female of L. quadrispinosa remains undescribed.

2. Cibarium with 4-5 horizontal teeth. ..... 3

Cibarium with 6 or more horizontal teeth. ..... 6

3. Spermathecae smooth walled & elongate, its length about 4X maximum width. ..... L. lewisi (Pl. 34-6)

Spermathecae pear-shaped or subspherical, not elongate; incipient or complete annuli may be apparent. ..... 4

4. Cibarium with 4 conspicuous horizontal teeth plus a small median horizontal tooth. Pharynx lacking heavily sclerotized transverse bands. ..... L. cubensis (Pl. 34-14)

Cibarium with 4 horizontal teeth. Pharynx with heavily sclerotized transverse bands. ..... 5

5. Cibarium with very short horizontal teeth; pigment patch broad & with numerous vertical teeth. Spermathecae slightly constricted in middle. ..... L. atroclavata (Pl. 34-3)

Cibarium with well developed horizontal teeth; pigment patch more slender with few or no vertical teeth. Spermathecae subspherical, lacking median constriction. ..... L. venezuelensis (Pl. 34-3)

6. Cibarium with 30+ horizontal teeth in a comb-like row. ..... L. ctenidophora (Pl. 34-13)

Cibarium with fewer horizontal teeth in a comb-like row or not. ..... 7

7. Cibarium with 6-9 horizontal teeth. ..... 8

Cibarium with 10 or more horizontal teeth. ..... 9

8. Pharynx greatly expanded at posterior end. Scutum pale. Flagellomere I considerably longer than labrum.. L. duppyorum (Pl. 34-8)

Pharynx but slightly widened at posterior end. Scutum dark. Flagellomere I shorter than labrum. .....

..... Lutzomyia (Micropygomyia) n.sp. #1 (Pl. 34-15)

9. Spermathecae with terminal knob inserted into a prominent depression. ..... L. wirthi

Spermathecae with terminal knob inserted otherwise. ..... 10

10. Wing venation with delta less than half length of alpha. ..... 11

Wing venation with delta longer than half length of alpha. ..... 12

11. Spermathecae with relatively wide individual ducts, at least 4X maximum width of terminal knob. Scutum and pleura light brown.

..... L. durani (Pl. 34-1)

Spermathecae with very slender individual ducts, more or less equal to maximum width of terminal knob. Scutum, proepimeron & katepisternum dark, pleura pale. ..... L. yencanensis (Pl. 34-5)

12.* Cibarium with 4 vertical teeth; pale species. ..... 13

Cibarium with 6 or more vertical teeth; dark species (except possibly for L. c. puertoriciensis). ..... 15

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*Adapted from Lewis (1967b).

13. Cibarium with median horizontal teeth shorter than ½ internal width of cibarium. ..... L. c. viequesensis (Pl. 34-10)

Cibarium with median horizontal teeth as long as, or longer than, ½ internal width of cibarium. ..... 14

14. Cibarium with median horizontal teeth subequal to ½ internal width of cibarium. ..... L. c. jamaicensis (Pl. 34-13)

Cibarium with longer median horizontal teeth, greater than ½ external width of cibarium. ..... L. c. braci (Pl. 34-11)

15. Cibarium with median horizontal teeth shorter than ½ internal width of cibarium. ..... L. c. cayennensis (Pl. 34-12)

? L. farilli

Cibarium with median horizontal as long as, or longer than, ½ internal width of cibarium. ..... 16

16. Cibarium with prominent vertical teeth, those in middle larger than others. ..... L. c. maciasi (Pl. 34-10)

Cibarium without prominent vertical teeth, those in middle not markedly larger than others. ..... L. c. hispaniolae (Pl. 34-10)

L. c. puertoriciensis (Pl. 34-10)

17. Cibarium with each pair of horizontal teeth inserted on common base; numerous & prominent lateral teeth present. Spermathecae annulated & elongate, length about 4X maximum width; individual sperm ducts become wider towards common duct. ..... L. minasensis (Pl. 34-7)

L. oliveirai (Pl. 34-7)

Cibarium with horizontal teeth inserted individually; no lateral teeth. Spermathecae annulated basally but subspherical, individual ducts not tapered, subequal in width throughout. ..... 18

18. Cibarium with 4 horizontal teeth not in a comb-like row. ..... 19

Cibarium with 16-28 horizontal teeth in comb-like row. ..... L. chiapanensis (Pl. 34-2)

19. Pleura dark. Profemur shorter than protibia.... L. micropyga (Pl. 34-9)

Pleura pale. Profemur longer than protibia.... L. schreiberi (Pl. 34-8)

Lutzomyia (Micropygomyia) durani (Vargas & Najera)

Plate 34-1

Phlebotomus durani Vargas & Najera 1952: 68 (♂, Nocupetaro, Michoacán, Mexico; ♀, Iguala, Guerrero, Mexico); 1953b: 310 (listed). Rosabal & Trejos 1964: 167; 1965: 222 (El Salvador).

Lutzomyia durani: Barretto 1962: 96 (listed). Theodor 1965: 187 (listed). Forattini 1973: 342 (♂, ♀ figs., tax.). Martins et al. 1978: 68 (listed). Navin et al. 1985: 1074 (Honduras).

Distribution (Map 34-1). Mexico (Vargas & Najera 1952 & ♂♂, ♀♀, Miacatlán, Morelos, 1980, M. Camino). Honduras (Navin et al. 1985); El Salvador (Rosabal & Trejos 1964; 1965).

Remarks. The provisional record of L. durani in northern El Salvador (Rosabal & Trejos 1964, 1965) is probably correct in view of its recent discovery in southern Honduras (Navin et al. 1985).

## Lutzomyia (Micropygomyia) chiapanensis (Dampf)

Plate 34-2

Phlebotomus chiapanensis Dampf 1947b: 180 (♀, Chiapa de Corzo, Chiapas, Mexico). Fairchild & Hertig 1948b: 456 (♂, ♀). Vargas & Najera 1953b: 310 (dist., Mexico). Fairchild & Hertig 1959: 122 (dist., Mexico & Central America). Rosabal & Trejos 1964: 167; 1965: 222 (El Salvador).

Lutzomyia chiapanensis: Barretto 1962: 95 (listed). Theodor 1965: 187 (listed). Forattini 1973: 339 (♂, ♀ figs., tax.). Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 67 (♂, ♀ figs., dist.). Navin et al. 1985: 1074 (Honduras). Murillo & Zeledón 1985: 114 (♂, ♀ figs., Costa Rica).

Distribution (Map 34-2). Mexico; El Salvador (Martins et al. 1978); Honduras (Intermill & Muller 1976; Navin et al. 1985); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978).

Remarks. There is a strong possibility that L. chiapanensis and L. californica are conspecific (see Young & Perkins 1984).

Lutzomyia (Micropygomyia) atroclavata (Knab)

Plate 34-3

Phlebotomus atroclavatus Knab 1913: 135 (♂, ♀, Gasparee Island, Trinidad). Dampf 1947a: 296 (figs., refs.). Fairchild & Hertig 1948b: 455 (♂, ♀, tax., refs.).

Flebotomus atroclavatus: Barretto 1947a: 186 (full refs.).

Phlebotomus tejerae Larrousse 1922: 71 (♂, ♀, Zulia, Venezuela). Dyar 1929: 120 (as synonym of atroclavatus).

Phlebotomus guadeloupensis Floch & Abonnenc 1945a: 1 (♂, ♀, Guadeloupe, W.I.). Fairchild & Hertig 1948b: 456 (as synonym of atroclavatus).

Lutzomyia atroclavata: Theodor 1965: 195 (♀ figs.). Forattini 1973: 211 (♂, ♀ figs., tax.). Martins et al. 1978: 129 (♂, ♀ figs., dist.). Ramirez Perez et al. 1978: 49 (♂, ♀ figs., Aragua, Venezuela). Young 1979: 218 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Perez et al. 1982a: 14 (♂, ♀ figs., Sucre, Venezuela); 1982b: 57 (figs., Tachira, Venezuela). Murillo & Zeledón 1985: 109 (figs., Costa Rica). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela). Young et al. 1987: 588 (Norte de Santander, Colombia).

Distribution (Map 34-1). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Martins et al. 1978; Young 1979; Young

et al. 1987); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978; 1982a,b; Feliciangeli 1987a,b); West Indies (Martins et al. 1978).

Remarks. Courmes et al. (1966) suggested that L. atroclavata (as guadeloupensis) was a possible vector of Leishmania chagasi on the island of Guadeloupe because it was the only sand fly collected by them from there. However, there is no other evidence to support this hypothesis. Females are not anthropophilic.

Lutzomyia (Micropygomyia) venezuelensis (Floch & Abonnenc)

Plate 34-3

Phlebotomus venezuelensis Floch & Abonnenc 1948b: 1 (♂, Selva de Tamanaco, Zulia, Venezuela). Pifano et al. 1962: 403 9 (♂, ♀). Forattini 1973: 312 (incorrectly as synonym of oswaldoi).

Phlebotomus zuliaensis Floch & Abonnenc 1948b: 5 (♀, Zulia, Venezuela). Scorza & Ortiz 1960: 434 (as probable synonym of venezuelensis). Forattini 1971a: 101; 1973: 281 (incorrectly as synonym of atroclavatus).

Lutzomyia venezuelensis: Barretto 1962: 96 (listed). Lewis 1975a: 502 (mouthpart morphol.). Ramirez Perez 1978: 52 (Aragua, Venezuela). Martins et al. 1978: 132 (refs., dist.). Young 1979: 220 (figs., refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Perez et al. 1982a: 14 (♂, ♀ figs., Sucre, Venezuela); 1982b: 58 (♂, ♀ figs., Tachira, Venezuela).

Lutzomyia zuliaensis: Theodor 1965: 195 (cf. to atroclavata).

Distribution (Map 34-2). Colombia (Martins et al. 1978; Young 1979); Venezuela (Martins et al. 1978; Ramirez Perez 1982a,b).

Remarks. We have observed 15+ venezuelensis females collected near Durania, Norte de Santander, Colombia, in 1986 & 1987, naturally infected with trypanosomes in the hind guts of the flies (Young, Morales, Ferro et al., unpub. data). We suspect that the vertebrate hosts of these parasites are lizards.

Males and females are commonly found resting in rock crevices and on tree trunks at this site. Numerous human bait collections were carried out for more than a year at Durania; no females were captured.

Ramirez Perez et al. (1978) figured the male and female of L. venezuelensis and other species, including the female of L. micropyga which, however, more closely resembles that of L. venezuelensis and may be a misidentification.

## Lutzomyia (Micropygomyia) quadrispinosa (Floch & Chassignet)

Plate 34-4

Phlebotomus quadrispinosus Floch & Chassignet 1947b: 2 (♂, Baduel, French Guiana). Floch & Abonnenc 1952: 142 (♂ fig., redescript.). Forattini 1973: 310 (as synonym of micropygus & minasensis).

Lutzomyia quadrispinosa: Barretto 1962: 96 (as member of subgenus Scoipemyia). Theodor 1965: 187 (listed). Leger et al. 1977: 221 (as distinct species). Martins et al. 1978: 64 (refs.). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 34-3). French Guiana (type locality).

Remarks. Lutzomyia quadrispinosa is known only from the holotype male in the collection of the Institute Pasteur, Paris. We studied this specimen in 1987, through the courtesy of F. Rodhain, and noted the following.

Whole insect, including the scutum, pale possibly because of intense maceration. Wing length 1.70 mm; width 0.46 (slightly shorter than 1.95 mm length given in original description). Antennal ascoid nearly reaching end of flagellomere II & simple. Palpomere length (1, 0.04; 2, 0.153; 3, 0.189; 4, 0.106; 5, 0.28 but shrunken). Aedeagus not seen due to the dissected terminalia; genital pump & filaments not discernible as noted by Floch & Abonnenc (1952). The legs are detached from the thorax & are mounted under a separate coverslip. Measurements of the hind leg given by Floch & Chassignet (1947b) and repeated by Floch & Abonnenc (1952) were actually those of the mid leg. Length of the femorae, tibiae & basitarsi: foreleg, 0.54, 0.79-0.84, 0.56-0.58; midleg, 0.49-0.53, 1.07-1.09, 0.66-0.68; hindleg, 0.51-0.53, 1.22, 0.68. Six legs were measured. Other measurements closely agree with those given in the original description.

This species is clearly distinct from L. micropyga and L. minasensis, as noted by Leger et al. (1977) who disagree with Forattini's (1973) proposed synonym.

Lutzomyia (Micropygomyia) yencanensis (Ortiz)

Plate 34-5

Phlebotomus yencanensis Ortiz 1965a: 208 (♂, ♀, Rancho Grande, Aragua, Venezuela). Scorza et al. 1966d: 90 (measurements). Forattini 1971.

Phlebotomus cayennensis (not cayennensis Floch & Abonnenc): Scorza & Ortiz 1960: 433.

Lutzomyia yencanensis: Forattini 1971a: 101 (listed); 1973: 336 (as synonym of cayennensis). Martins et al. 1978: 65 (listed). Ramirez Perez et al. 1978: 61 (as synonym of cayennensis).

Distribution (Map 34-4). Venezuela (type locality); Colombia (♂♂, ♀♀, Durania, Norte de Santander, Colombia, 900 m above sea level, 1986-1987, D. Young, A. Morales & C. Ferro).

Remarks. This species has not been previously illustrated. We examined topotypes, graciously provided by D. Feliciangeli, and observed that they and the specimens from Durania, Colombia, were identical in structure and coloration. Further studies may show that L. yencanensis is a subspecies of L. cayennensis.

At Durania, Colombia, we have collected females naturally infected with trypanosomes similar to those found in L. venezuelensis that occurs at the same site (Young, Morales & Ferro, unpub. data). We have also collected females of L. yencanensis as they were feeding on small lizards.

Lutzomyia (Micropygomyia) lewisi Feliciangeli, Ordonez & Fernandez

Plate 34-6

Lutzomyia lewisi Feliciangeli, Ordonez & Fernandez 1984a: 359 (♀, La Vaquira, Cojedes, Venezuela).

Distribution (Map 34-5). Venezuela (type locality).

Remarks. The spermathecae of L. lewis are markedly different from those of other species in this subgenus. The male, partially illustrated here, will be fully described by D. Feliciangeli in a forthcoming publication.

Lutzomyia (Micropygomyia) oliveirai Martins, Falcao & Silva

Plate 34-7

Lutzomyia oliveirai Martins, Falcao & Silva 1970b: 550 (♂, ♀, Serra do Cipó, Minas Gerais, Brazil). Forattini 1973: 312 (♂, ♀ figs., tax.). Martins et al. 1978: 64 (refs., dist.). Galati et al. 1985: 261 (Mato Gross do Sul, Brazil).

Distribution (Map 34-2). Brazil (Martins et al. 1978).

Remarks. Specimens of L. oliveirai have been captured in rock crevices and small caves in Brazil.

## Lutzomyia (Micropygomyia) minasensis (Mangabeira)

Plate 34-7

Flebotomus minasensis Mangabeira 1942a: 136 (♂, Januária, Minas Gerais, Brazil).

Lutzomyia minasensis: Barretto 1962: 96 (in subgenus Sciopemyia). Theodor 1965: 187 (listed). Martins et al. 1970b: 551 (♂ figs., tax. ♀). Forattini 1973: 310 (as synonym of micropyga). Martins et al. 1978: 64 (dist., refs.).

Distribution (Map 34-6). Brazil (Martins et al. 1978).

Remarks. The female of L. minasensis cannot be distinguished from that of L. oliverai (see Martins et al. 1970b). It and the male, however, are markedly different in structure and coloration from that of L. micropyga which Forattini (1973) erroneously treats as a senior synonym of L. minasensis.

## Lutzomyia (Micropygomyia) duppyorum (Fairchild & Trapido)

Plate 34-8

Phlebotomus duppyorum Fairchild & Trapido 1950: 412 (♂, ♀, near Ferry River, Kingston, Jamaica). Ortiz 1965a: 209 (♀ keyed).

Lutzomyia duppyorum: Barretto 1962: 95 (listed). Theodor 1965: 187 (listed). Forattini 1973: 341 (figs., tax.). Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 63 (dist.).

Distribution (Map 34-4): Jamaica (Martins et al. 1978).

Remarks. The diurnal resting sites of this species in Jamaica include tree trunks, especially Ceiba trees. One of us (D.Y.) captured both sexes in holes of a concrete wall near Montego Bay in 1969.

Lutzomyia (Micropygomyia) schreiberi Martins, Falcão & Silva

Plate 34-3

Lutzomyia schreiberi Martins, Falcao & Silva 1975a: 769 (♂, ♀, Vitória, Esprito Santo, Brazil). Martins et al. 1978: 65 (♀ figs., dist.). Young 1979: 217 (cf. to micropygus). Mayrink et al. 1979: 131 (Minas Gerais, Brazil).

Phlebotomus micropygus (not micropygus Mangabeira): Sherlock & Carneiro 1962: 430 (♀); 1964: 207 (♂). Sherlock & Pessoa 1966: 47 (natural flagellate infections).

Lutzomyia micropyga (in part): Forattini 1973: 312.

Distribution (Map 34-4). Brazil (Martins et al. 1978).

Remarks: Sherlock & Pessoa (1966) in Bahia, Brazil, found 12 of 368 females of L. schreiberi (as micropyga) infected with flagellates believed to be parasites of geckoes.

## Lutzomyia (Micropygomyia) micropyga (Mangabeira)

Plate 34-9

Flebotomus micropygus Mangabeira 1942a: 132 (♂, Aurá, Belém, Pará, Brazil).

Lutzomyia micropyga: Barretto 1962: 96 (listed). Leger et al. 1977: 221 (French Guiana). Ramirez Perez et al. 1978: 49 (♂, ? ♀ figs., Aragua, Venezuela). Martins et al. 1978: 63 (refs., dist.). Young 1979: 215 (♂, ♀, refs.). Feliciangeli 1980: 246 (figs., keyed). Ramirez Perez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela records). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Freitas 1982: 404 (Acre, Brazil). Young & Rogers 1984: 599 (listed, Ecuador). Young et al. 1985: 145 (Peru). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Murillo & Zeledón 1985: 114 (figs., Costa Rica). Ryan 1986: 26 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 28 (computer aided ident.).

Distribution (Map 34-3). Costa Rica (Murillo & Zeledón 1985); Panama; Colombia; Ecuador (Young 1979); Peru; Bolivia; Trinidad (Martins et al. 1978); Brazil (Martins et al. 1978; Young 1979; Biancardi et al. 1982; Arias & Frietas 1982; Ryan 1986); Venezuela (Martins et al. 1978; Ramirez Perez et al., 1978; 1981; 1982a,b); French Guiana (Leger et al. 1977).

Remarks. Lutzomyia micropyga is a small dark sand fly often found resting in crevices of tree trunks. Tesh et al. (1971) identified blood meals from 4 micropyga females; two were of reptile/amphibian origins, one was mammalian, and one did not react with antisera.

Llanos et al. (1976) described and illustrated the female of L. micropyga from Peru but there are 7-8 horizontal teeth in the cibarium, not 4 as observed in females from Colombia (Young 1979). We suspect now that these specimens are not conspecific.

Lutzomyia (Micropygomyia) cayennensis viequesensis (Fairchild & Hertig)

Plate 34-10

Phlebotomus cayennensis viequesensis Fairchild & Hertig 1948b: 464 (♂, ♀, Laguna Yanuel, Vieques Island, Puerto Rico). Fairchild & Trapido 1950: 417 (St. Thomas, Virgin Islands).

Lutzomyia cayennensis viequesensis: Lewis 1967a: 80 (♀ keyed). Martins et al. 1978: 62 (dist.).

Distribution (Map 34-7). Puerto Rico; Virgin Islands (refs. given above).

Lutzomyia (Micropygomyia) cayennensis jamaicensis (Fairchild & Trapido)

Plate 34-13

Phlebotomus cayennensis jamaicensis Fairchild & Trapido 1950: 414 (♂, ♀, Rockfort, near Kingston, St. Andrew, Jamaica). Lewis & Garnham 1959: 85.

Lutzomyia cayennensis jamaicensis: Lewis 1967a: 79 (tax., keyed).

Distribution (Map 34-7). Jamaica (refs. given above).

## Lutzomyia (Micropygomyia) cayennensis braci Lewis

Plate 34-11

Lutzomyia cayennensis braci Lewis 1967a: 77 (♂, ♀, Bamboo Bay, Cayman Brac Island).

Distribution (Map 34-5). Cayman Brac Island (type locality).

## Lutzomyia (Micropygomyia) cayennensis cayennensis (Floch & Abonnenc)

Plate 34-12

Phlebotomus cayennensis Floch & Abonnenc 1941a: 13 (♂, Montjoly, Cayenne, French Guiana). Fairchild & Hertig 1948b: 460 (♂, ♀, refs., tax.).

Lutzomyia cayennensis: Barretto 1962: 95 (listed). Leger et al. 1977: 220 (French Guiana). Ramirez Perez et al. 1978: 49 (Aragua, Venezuela). Deane et al. 1978: 236 (infected with trypanosomes, Venezuela, as cayennense). Young 1979: 213 (♂, ♀, refs.). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Perez et al. 1981: 124; 1982a: 14; 1982b: 58 (Venezuela records, figs.). Zeledón et al. 1982: 276 (Honduras). Young & Rogers 1984: 599 (listed, Ecuador). Feliciangeli et al. 1984: 360

(Venezuela). Murillo & Zeledón 1985: 112 (♂, ♀ figs., Costa Rica). Lebbe et al. 1987: 28 (computer aided ident.) Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela).

Lutzomyia cayennensis cayennensis: Martins et al. 1978: 61 (♀ figs., refs., dist.).

Distribution (Map 34-7). Mexico; Belize; El Salvador (Martins et al. 1978); Honduras (Zeledón et al. 1982); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979); Ecuador (Young & Rogers 1984); Peru (Llanos 1981); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1981; 1982a,b; Feliciangeli 1987a); Trinidad (Young 1979); French Guiana (Martins et al. 1978).

Remarks. Additional studies of the nominate subspecies from countries listed above may show more variation than is now recorded. Females of L. c cayennensis have been found infected with trypanosomes in Venezuela (Deane et al. 1978) and in Colombia (Ryan et al. 1987c).

### Lutzomyia (Micropygomyia) farilli (Vargas & Najera)

Phlebotomus farilli Vargas & Najera 1959: 141 (♀, Acacoyahua, Chiapas, Mexico). Ortiz 1965a: 209 (keyed).

Lutzomyia farilli: Barretto 1962: 96 (listed). Lewis 1967a: 80 (mention). Forattini 1973: 336 (as synonym of cayennensis). Martins et al. 1978: 63 (refs., dist.).

Distribution (Map 34-6). Mexico (type locality).

Remarks. As other authors have suggested (Theodor 1965; Forattini 1973), L. farilli is probably conspecific with L. cayennensis but this can be determined only when additional material becomes available, or after careful study of the holotype.

Lutzomyia (Micropygomyia) cayennensis maciasi (Fairchild & Hertig)

Plate 34-10

Phlebotomus cayennensis maciasi (Fairchild & Hertig 1948b: 466 (♀, Zumpango, Guerrero, Mexico; ♂, Esquintla, Guatemala).

Lutzomyia cayennensis maciasi: Lewis 1967a: 79 (refs., ♀ keyed). Williams 1970: 333 (coll. data, Belize). Martins et al. 1978: 62 (dist.).

Distribution (Map 34-5). Mexico; Guatemala; Belize (Martins et al. 1978).

Remarks. Williams (1970) reported that nearly all of the females of L. cayennensis from Belize resembled L. c. maciasi. One female, however, resembled L. c. cayennensis. Lewis (1967a) noted that both these forms were found in the same locality in Mexico and suggested that "they should be regarded either as species or as minor variants."

## Lutzomyia (Micropygomyia) cayennensis hispaniolae

(Fairchild & Trapido)

Plate 34-10

Phlebotomus cayennensis hispaniolae Fairchild & Trapido 1950: 415 (♂, ♀, Seibo Prov., Dominican Republic).

Lutzomyia cayennensis hispaniolae: Lewis 1967a: 79 (listed). Martins et al. 1978: 62 (dist.). Johnson 1984: 29 (lab. colonization, dist., habits).

Distribution (Map 34-7). Dominican Republic (Johnson 1984); Haiti (Martins et al. 1978).

*Remarks*. Johnson (1984) observed that during the dry season in the Dominican Republic, from January to May, few adults of L. c. hispaniolae were captured from tree trunks. Females were commonly seen feeding on the backs of lizards in full sunlight. Johnson (1984) reared 5 larvae to adults that he collected from soil between the buttressed roots of a large tree in a coffee plantation at Monte Claro.

## Lutzomyia (Micropygomyia) cayennensis puertoricensis

(Fairchild & Hertig)

Plate 34-10

Phlebotomus cayennensis puertoricensis Fairchild & Hertig 1948b: 462 (♂, ♀, Lares, Puerto Rico). Fairchild & Trapido 1950: 416 (locality records, Puerto Rico, keyed).

Lutzomyia cayennensis puertoricensis: Lewis 1967a: 80 (♀ keyed).

Distribution (Map 34-5). Puerto Rico (Martins et al. 1978).

### Lutzomyia (Micropygomyia) wirthi (Vargas & Najera)

Phlebotomus wirthi Vargas & Najera 1951b: 103 (♀, Carrizal, Verracruz, Mexico); 1953b: 313 (listed). Ortiz 1965a: 209 (keyed). Forattini 1973: 336 (as synonym of cayennensis).

Lutzomyia wirthi: Barretto 1962: 96 (listed). Lewis 1967a: 79 (mention). Martins et al. 1978: 65 (refs., dist.).

Distribution (Map 34-3). Mexico (type locality).

Remarks. We have not examined the holotype female of L. wirthi, but it is likely that it is conspecific with another species in the subgenus.

### Lutzomyia (Micropygomyia) ctenidophora (Fairchild & Hertig)

Plate 34-31

Phlebotomus ctenidophorus Fairchild & Hertig 1948b: 466 (♀, Tamazunchale, San Luis Potosi, Mexico).

Lutzomyia ctenidophora: Barretto 1962: 95 (listed). Theodor 1965: 187 (listed). Forattini 1971a: 101; 1973: 341 (♀ figs.). Martins et al. 1978: 62 (listed).

Distribution (Map 34-6). Mexico (type locality).

Remarks. The male of this species has been collected in Mexico but remains undescribed (W. Hanson, pers. comm.).

Lutzomyia (Micropygomyia) cubensis (Fairchild & Trapido)

Plate 34-14

Phlebotomus cubensis Fairchild & Trapido 1950: 414 (♂, ♀, near Camaguey, Cuba). Ortiz 1965a: 290 (keyed).

Lutzomyia cubensis: Barretto 1962: 95. Young 1972: 63 (Florida, U.S.A.). Forattini 1973: 335 (figs., tax.). Lewis 1975a: 502 (mouthpart morphol.). Martins 1978: 62 (dist.). Young & Perkins 1984: 281 (refs., figs.).

Distribution (Map 34-2). U.S.A (Young & Perkins 1984); Cuba (Fairchild & Trapido 1950).

Lutzomyia (Micropygomyia) n.sp. #1

Plate 34-15

Distribution (Map 34-6). Venezuela (♂♂, ♀♀, La Morita & La Vaquira, Cojedes, 1984, D. Feliciangeli.

Lutzomyia (Micropygomyia) hardisoni (Vargas & Najera)

Phlebotomus hardisoni (Vargas & Najera 1952: 63 (♂, ♀, Iguala, Guerrero, Mexico). Ortiz 1965a: 205 (keyed). Forattini 1973: 336 (as synonym of cayennensis).

Lutzomyia hardisoni: Barretto 1962: 96 (listed). Forattini 1971a: 101 (listed). Martins et al. 1978: 63 (refs., dist.).

Distribution (Map 34-6). Mexico (type locality).

Remarks. Like L. farilli, this species may be conspecific with L. cayennensis as Forattini (1973) suggests.




Plate 34-1

Lutzomyia durani. A. Female head; B. Male head; C. Male flagellomere II; D. Female wing; E. Male wing; F. Male terminalia; G. Style with 5 spines; H. Spermathecae; I. Female cibarium & pharynx.

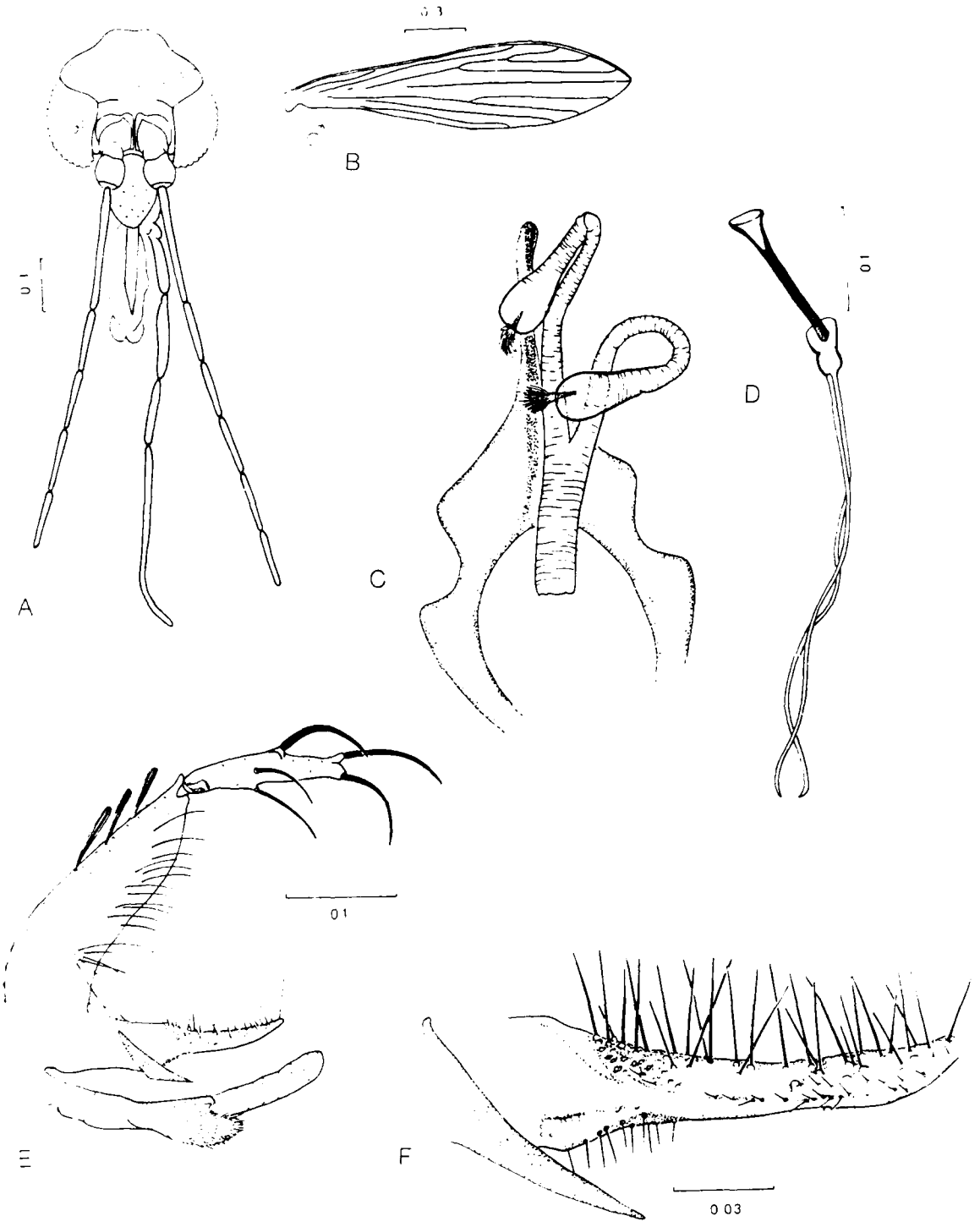



Plate 34-2

Lutzomyia chiapanensis. A. Male head; B. Male wing; C. Spermathecae; D. Genital pump & filaments; E. Male terminalia; F. Paramere.

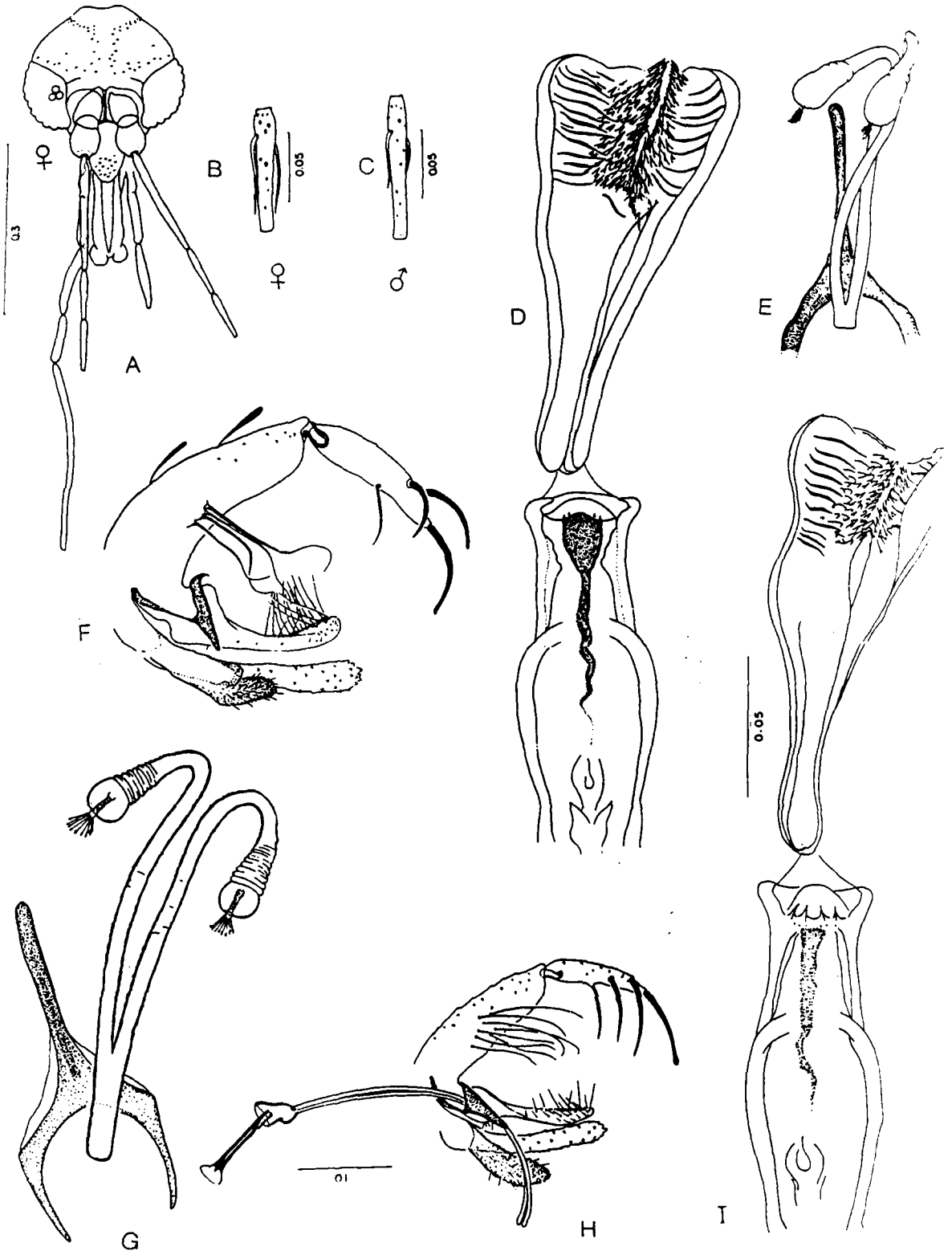



Plate 34-3

Lutzomyia atroclavata. A. Female head, B. Female flagellomere II, C. Male flagellomere II, D. Female cibarium & pharynx, E. Female spermathecae, F. Male terminalia (figs. A-C from Young 1979).

Lutzomyia venezuelensis. G. Female spermathecae, H. Male terminalia, I. Female cibarium & pharynx (figs. H & I from Young 1979).

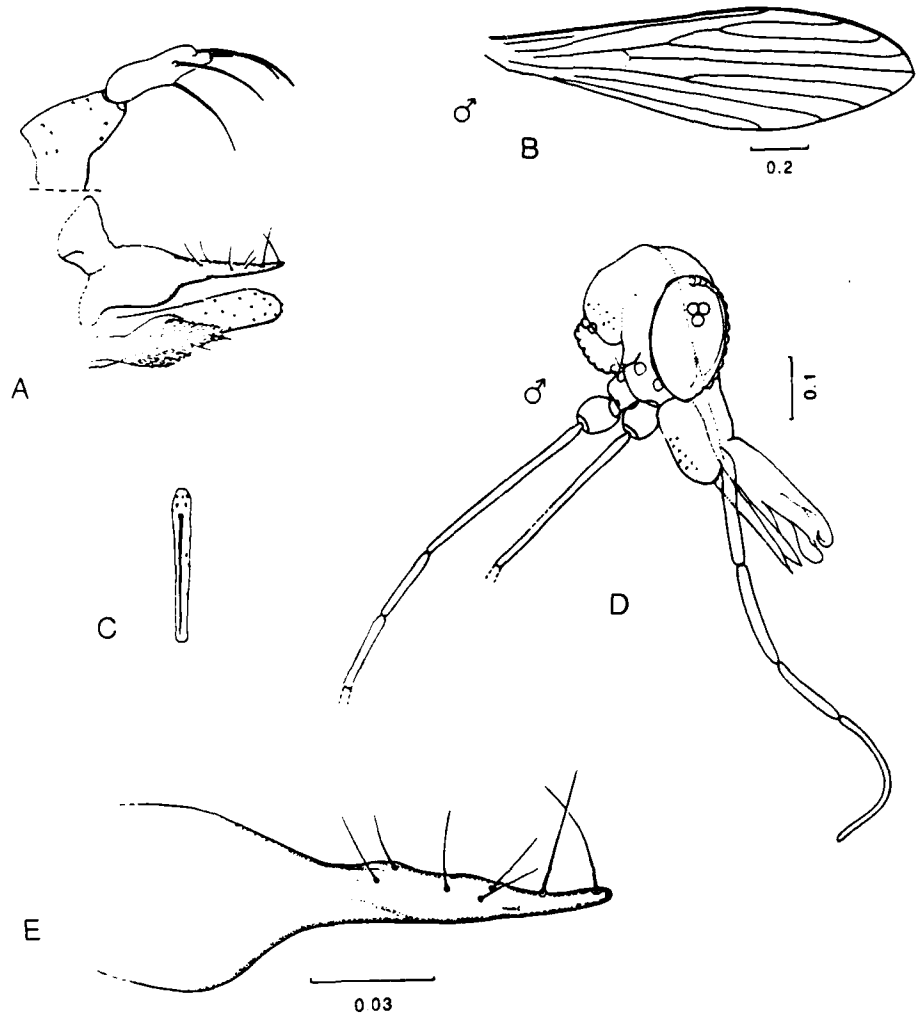



Plate 34-4

Lutzomyia quadrispinosa. A. Male terminalia; B. Male wing; C. Male flagellomere; D. Male head; E. Paramere.

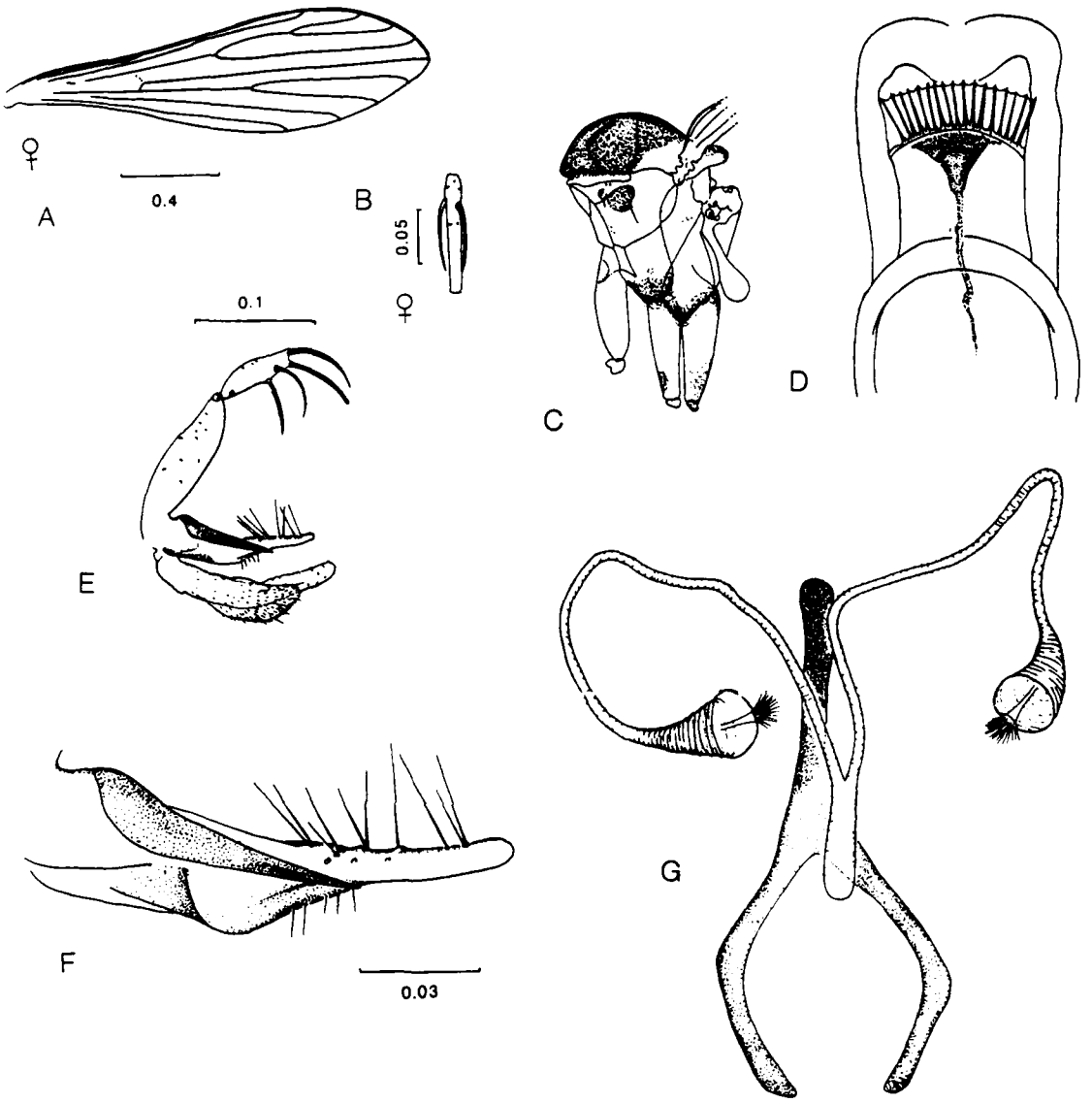



Plate 34-5

Lutzomyia yencanensis. A. Female wing; B. Female flagellomere II; C. Thorax; D. Female cibarium; E. Male terminalia; F. Paramere; G. Spermathecae.

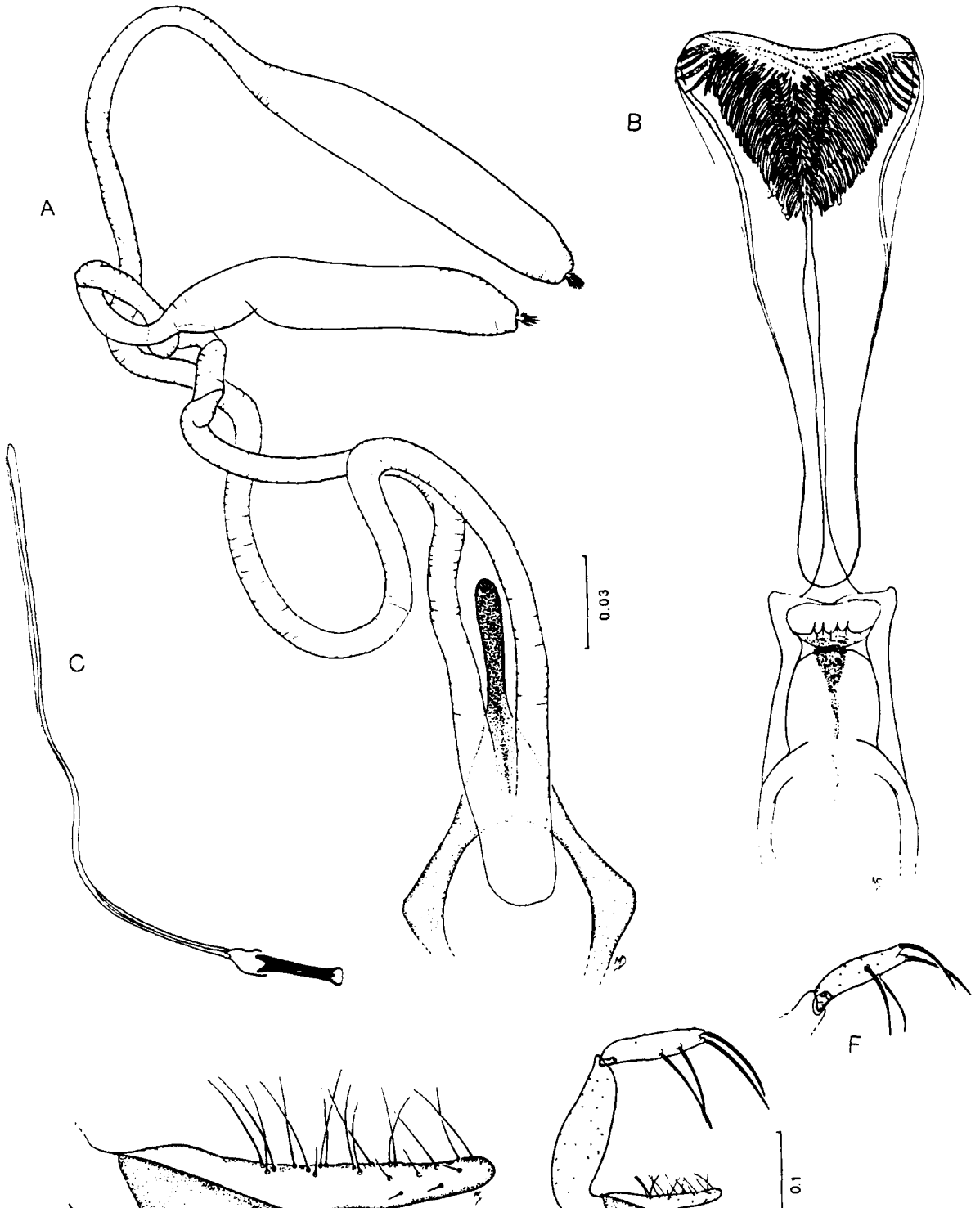



Plate 34-6

Lutzomyia lewisi. A. Spermathecae; B. Female cibarium & pharynx; C. Genital pump & filaments; D. Paramere; E. Male terminalia; F. Style.

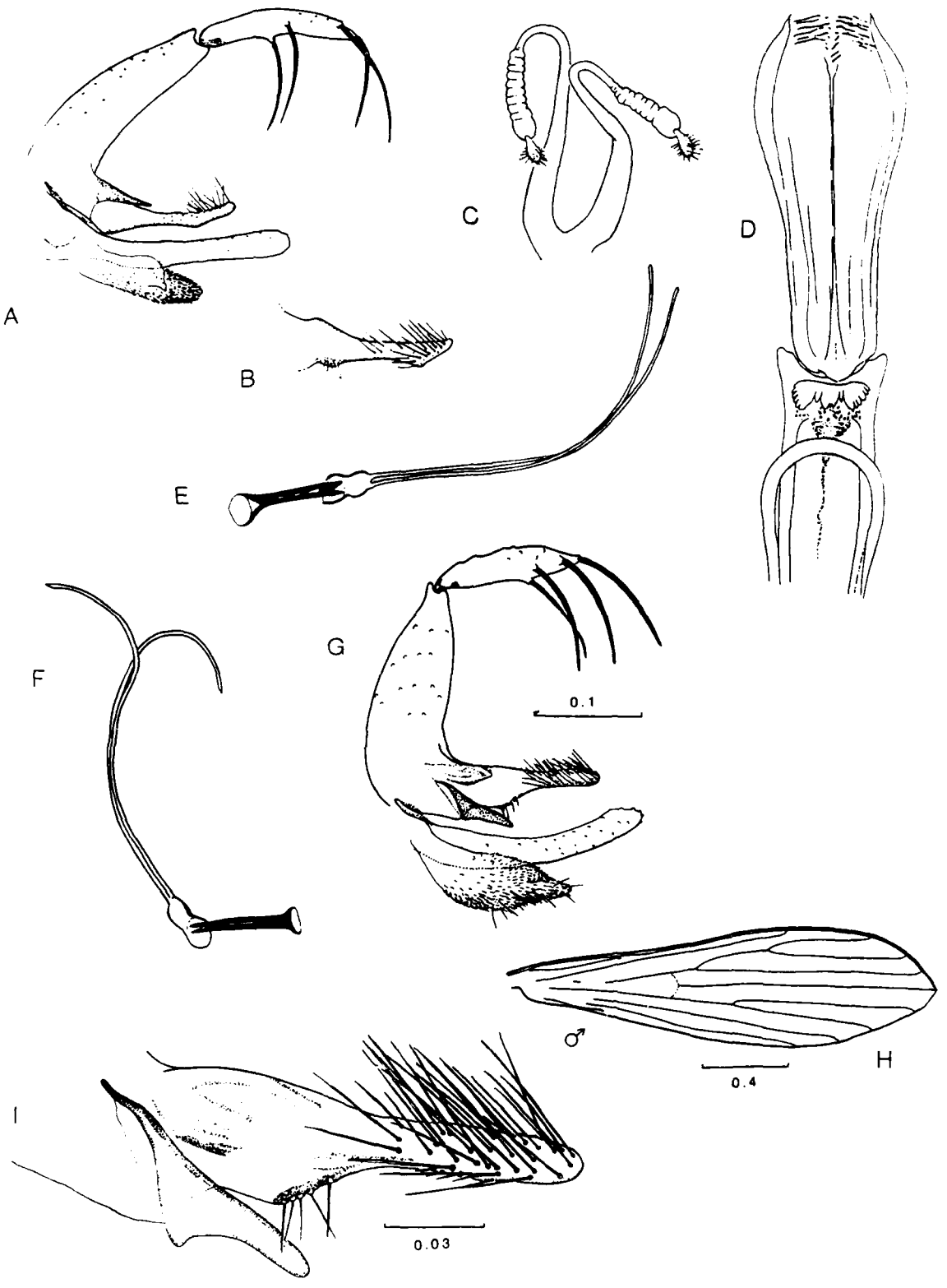



Plate 34-7

Lutzomyia oliveirai. A. Male terminalia; B. Paramere; C. Spermathecae; D. Female cibarium & pharynx; E. Gential pump & filaments (figs. C & D from Martins et al. 1970b).

Lutzomyia minasensis. F. Gential pump & filaments; G. Male terminalia; H. Male wing; I. Paramere.

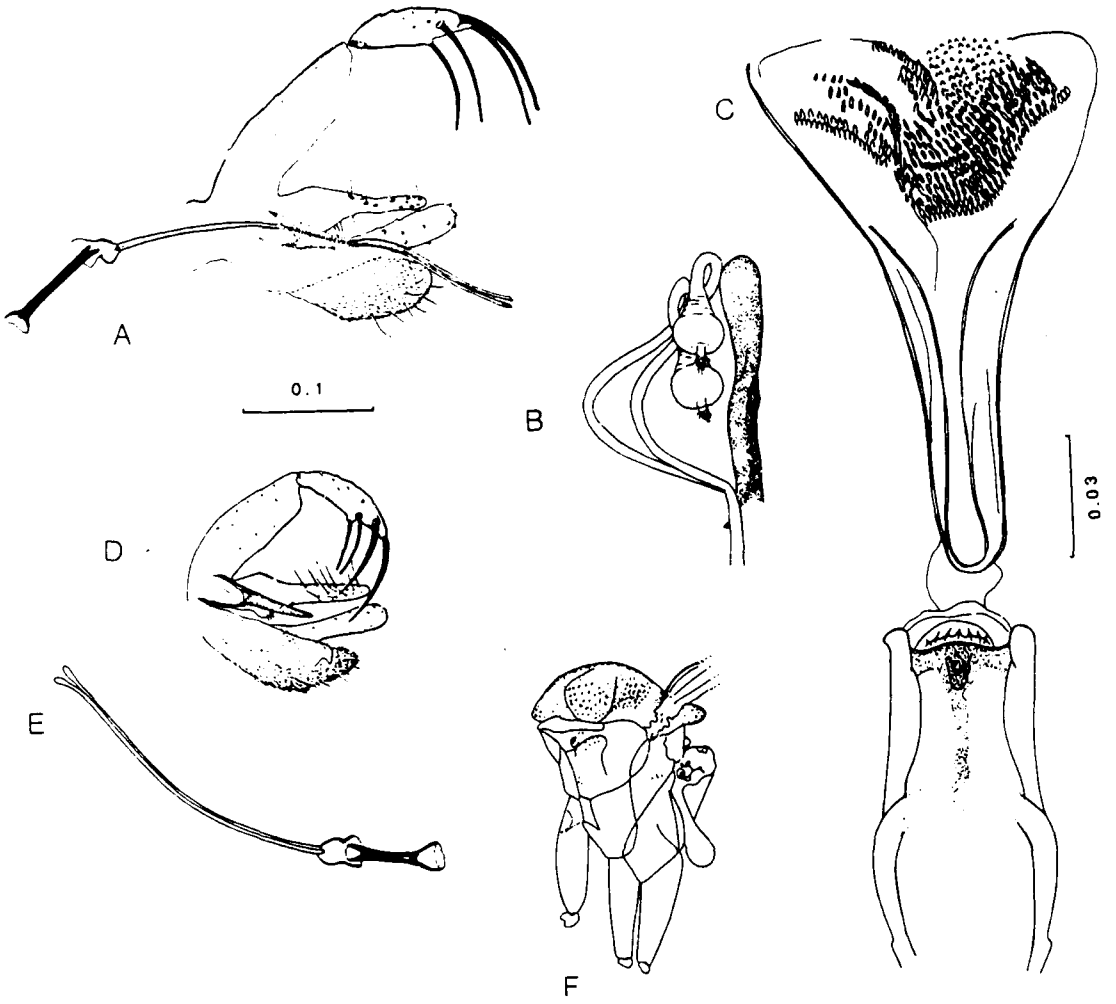



Plate 34-8

Lutzomyia duppyorum. A. Male terminalia; B. Spermathecae; C. Female cibarium & pharynx.

Lutzomyia schreiberi. D. Male terminalia; E. Gential pump & filaments; F. Thorax.

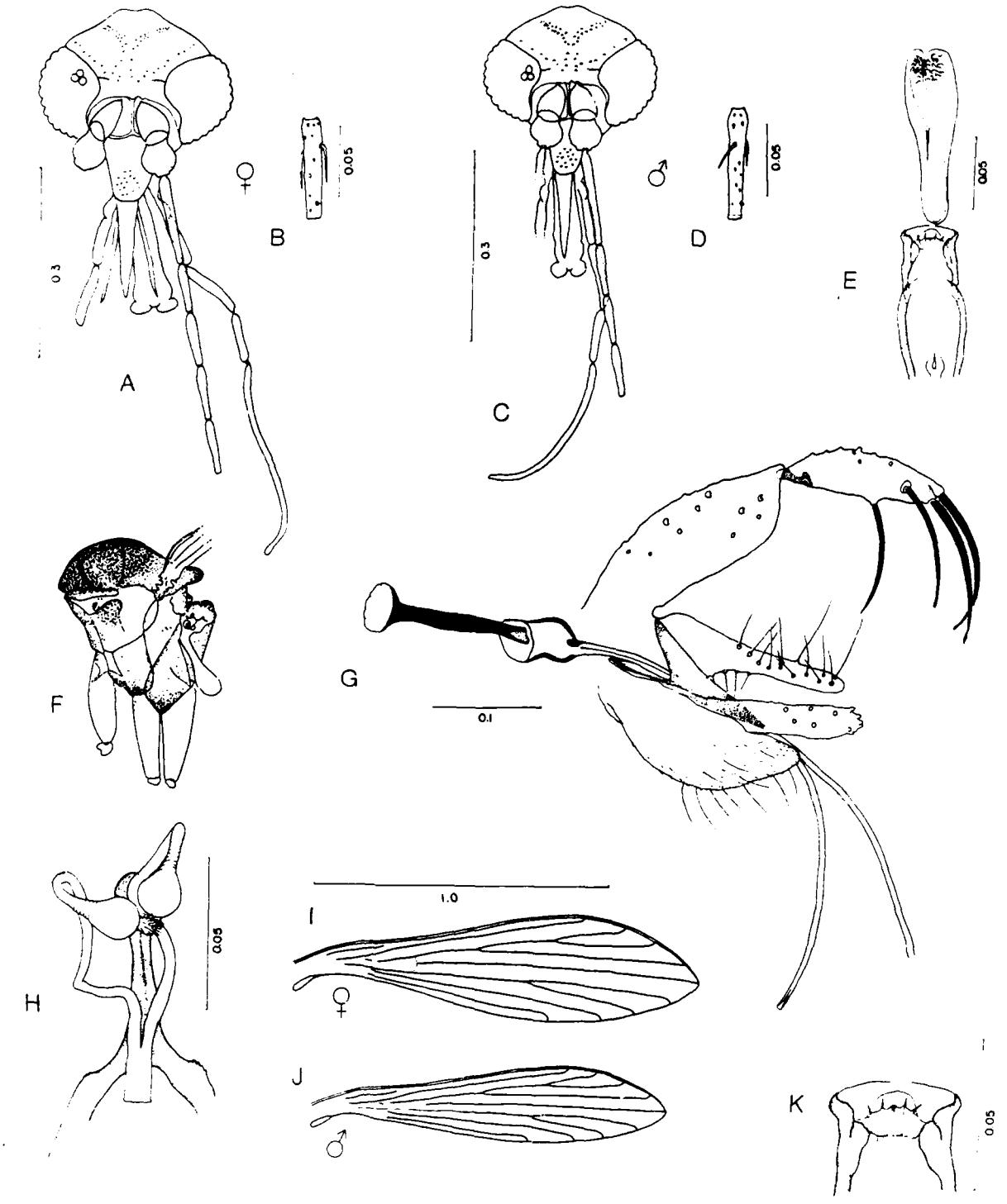



Plate 34-9

Lutzomyia micropyga. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Female cibarium & pharynx; F. Thorax; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing. K. Female cibarium (all figs. except F from Young 1979).

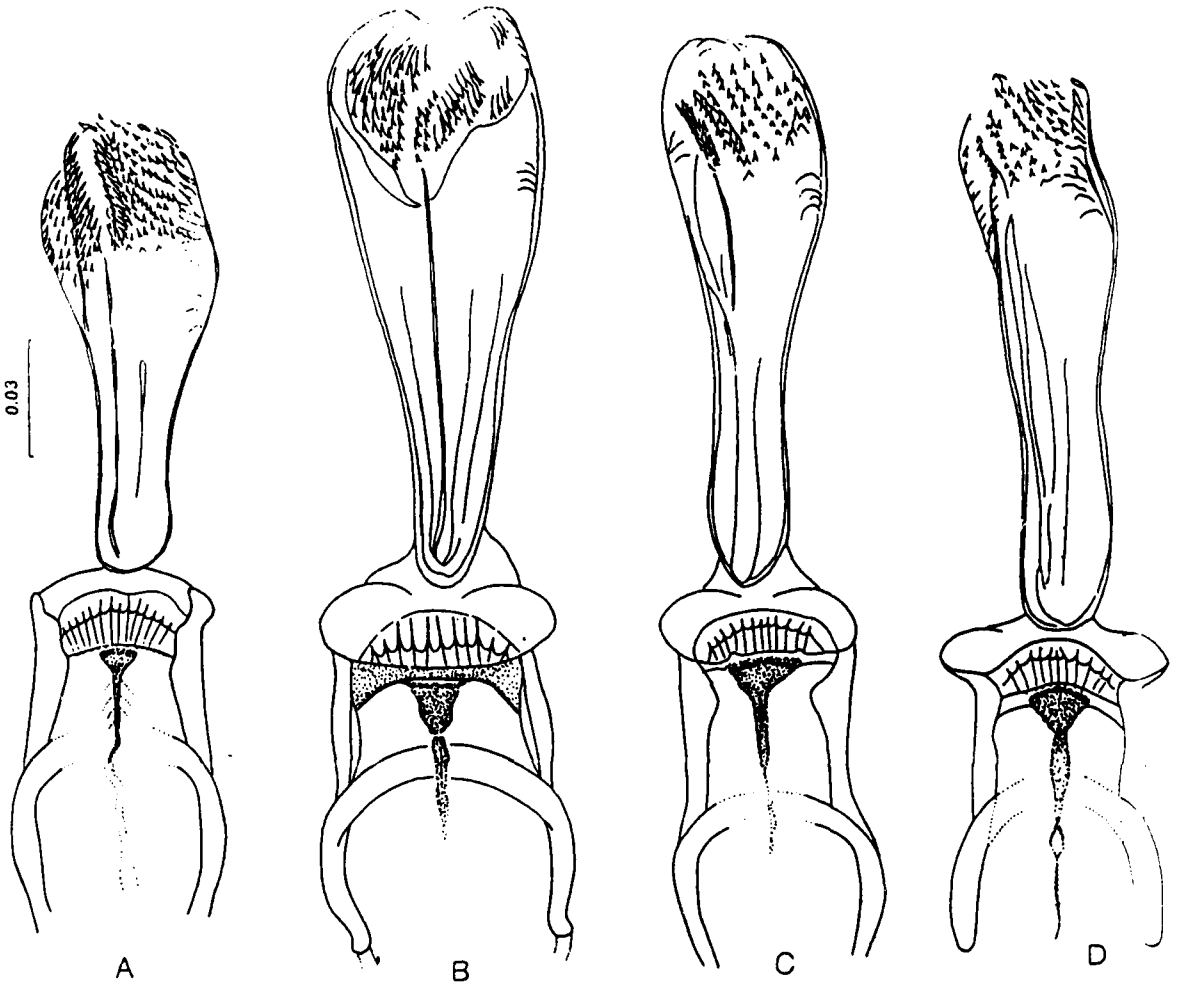



Plate 34-10

Lutzomyia cayennensis viequesensis. A. Female cibarium & pharynx.

Lutzomyia cayennensis maciasi. B. Female cibarium & pharynx.

Lutzomyia cayennensis hispaniolae. C. Female cibarium & pharynx.

Lutzomyia cayennensis puertoricensis. D. Female cibarium & pharynx.

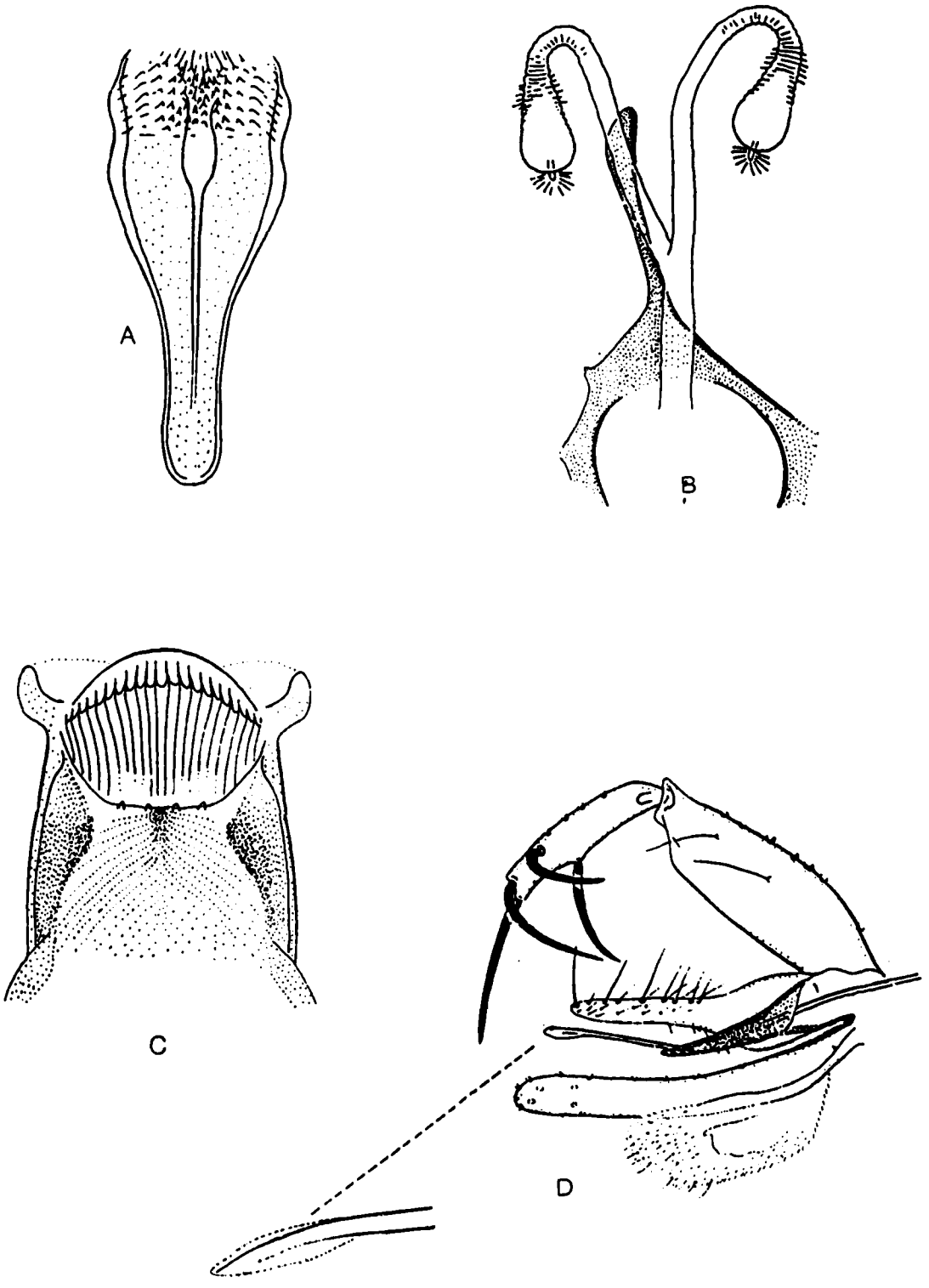



Plate 34-11

Lutzomyia cayennensis braci. A. Female pharynx; B. Spermathecae; C. Female cibarium; D. Male terminalia (figs. from Lewis 1967a).

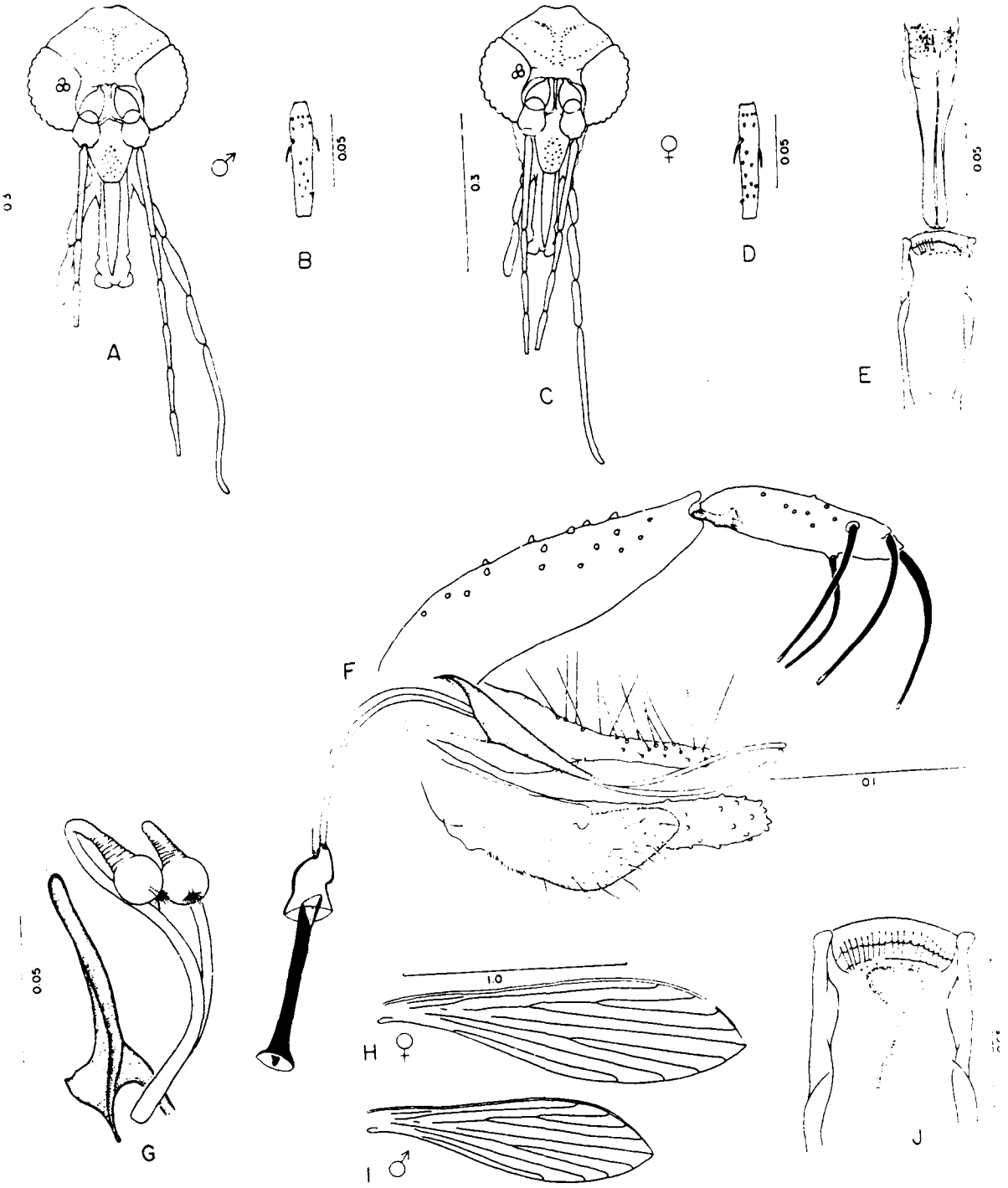



Plate 34-12

Lutzomyia cayennensis cayennensis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Male terminalia; G. Spermathecae; H. Female wing; I. Male wing; J. Female cibarium (from Young 1979).

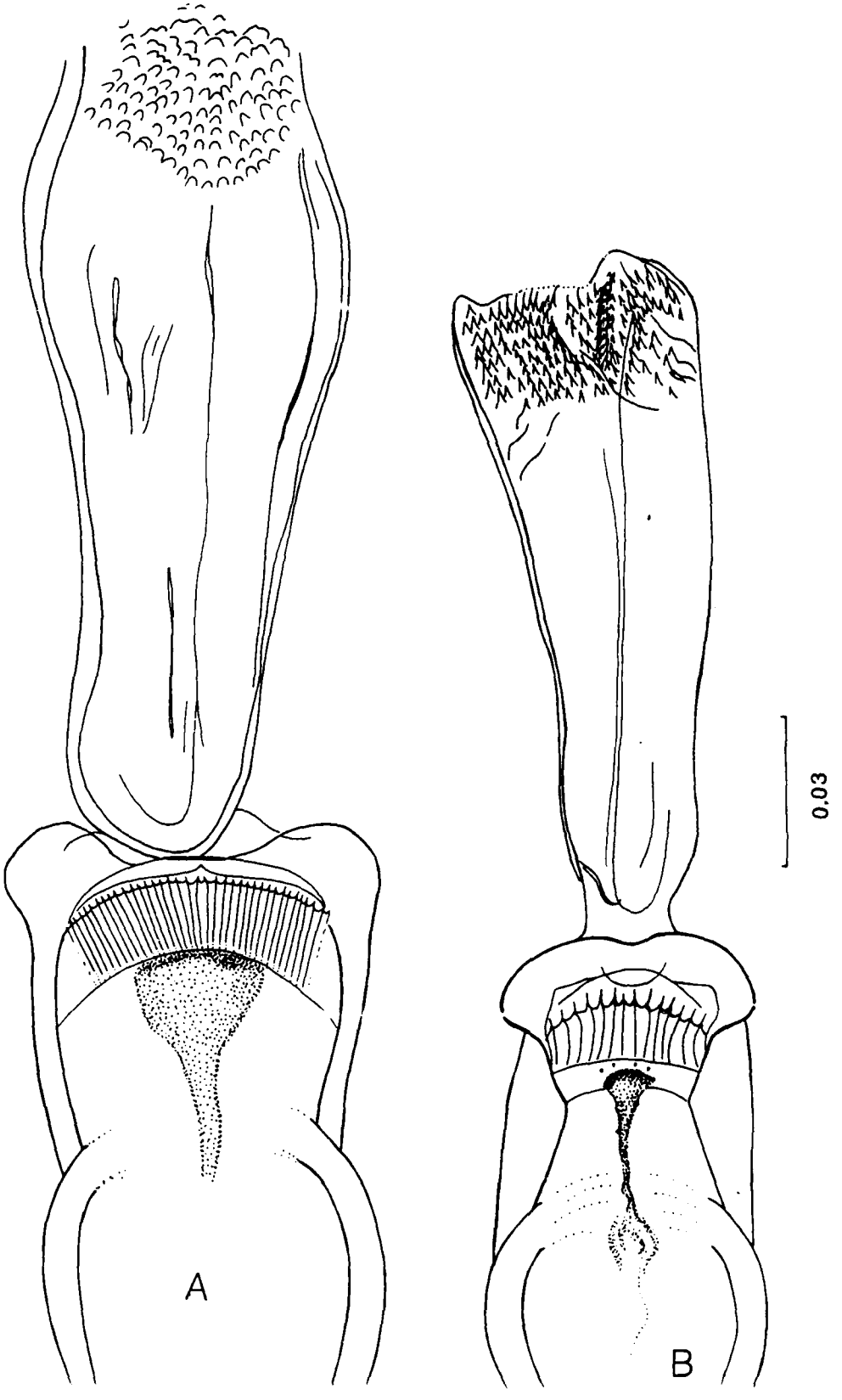



Plate 34-13

Lutzomyia ctenidophora A. Female cibarium & pharynx.

Lutzomyia cayennensis jamaicensis. B. Female cibarium & pharynx.

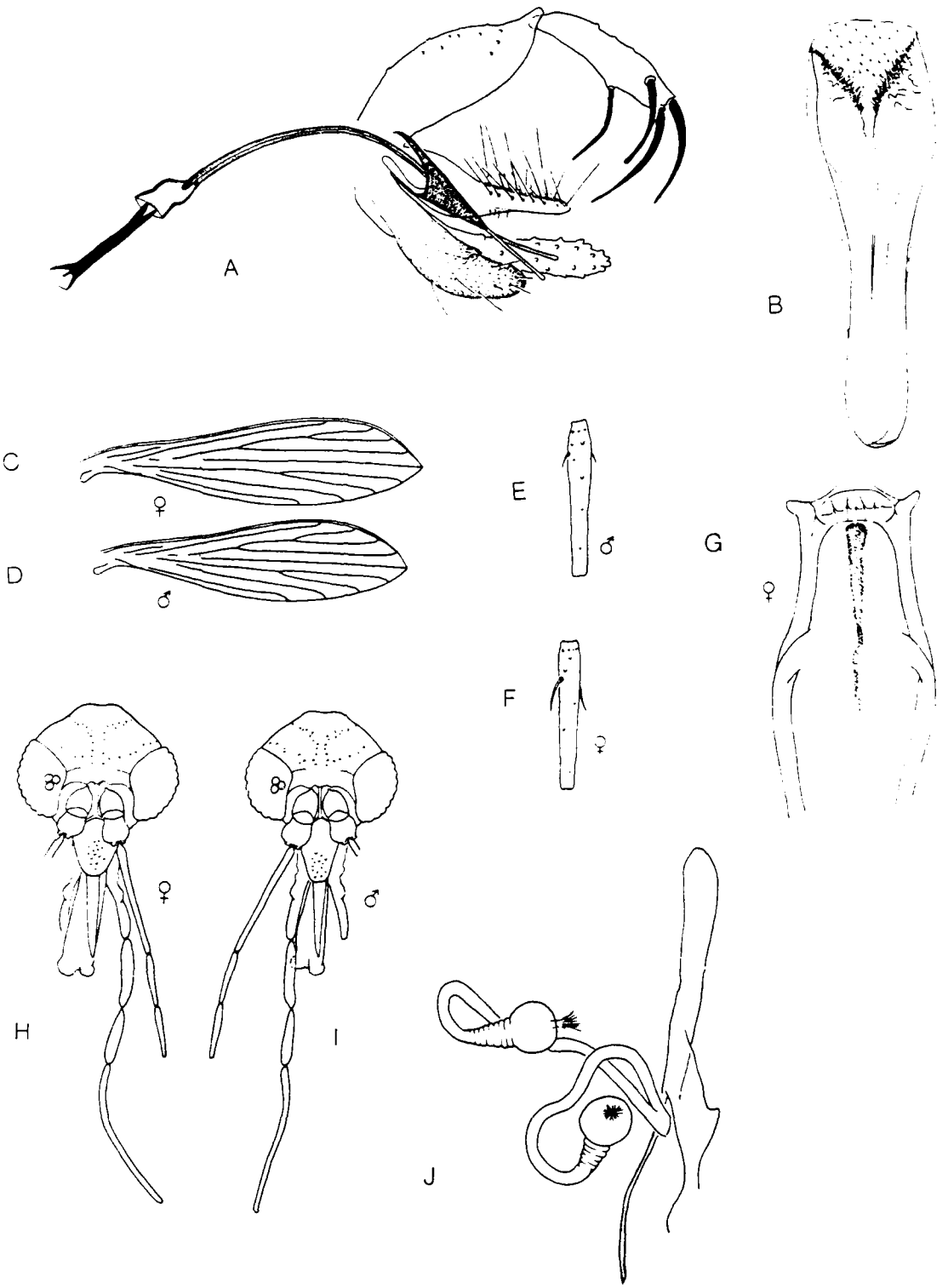



Plate 34-14

Lutzomyia cubensis. A. Male terminalia; B. Female pharynx; C. Female wing; D. Male wing; E. Male flagellomere II; F. Female flagellomere II; G. Female cibarium; H. Female head; I. Male head; J. Spermathecae (from Young & Perkins 1984).

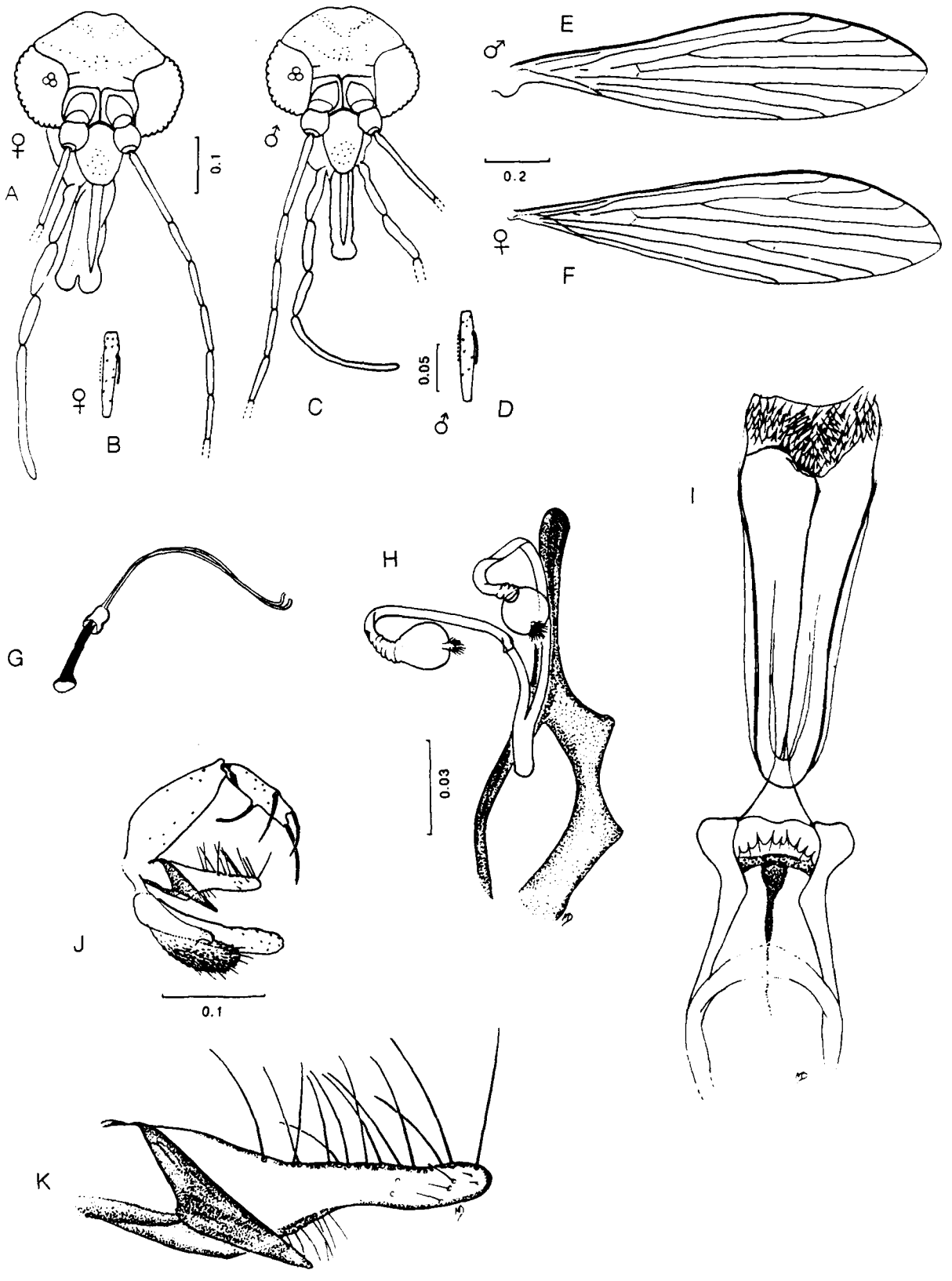
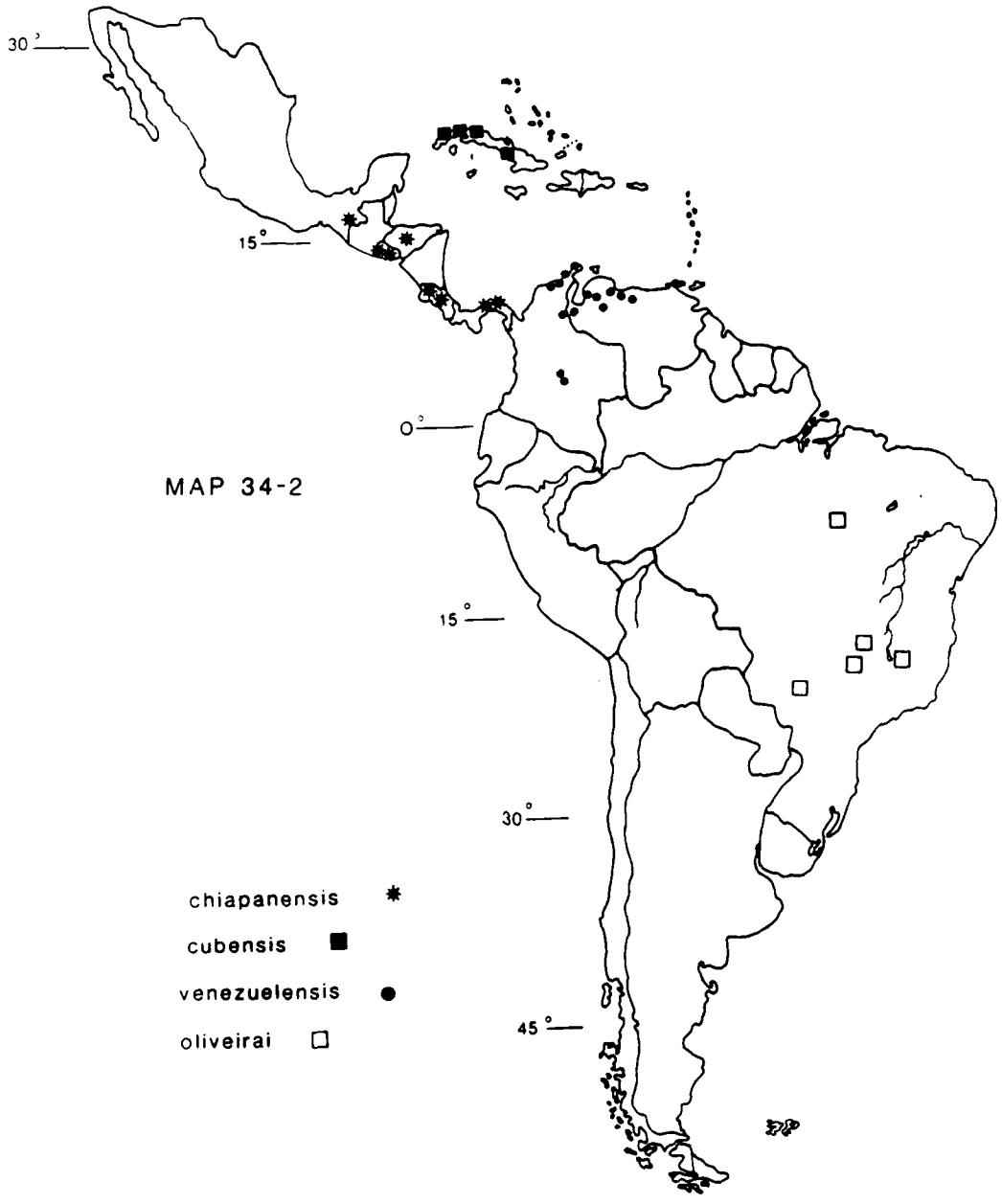



Plate 34-15

Lutzomyia (Micropygomyia) n.sp. #1. A. Female head; B. Female flagellomere II; C. Male head; D. Male flagellomere II; E. Male wing; F. Female wing; G. Genital pump & filaments; H. Spermathecae; I. Female cibarium & pharynx; J. Male terminalia; K. Paramere.



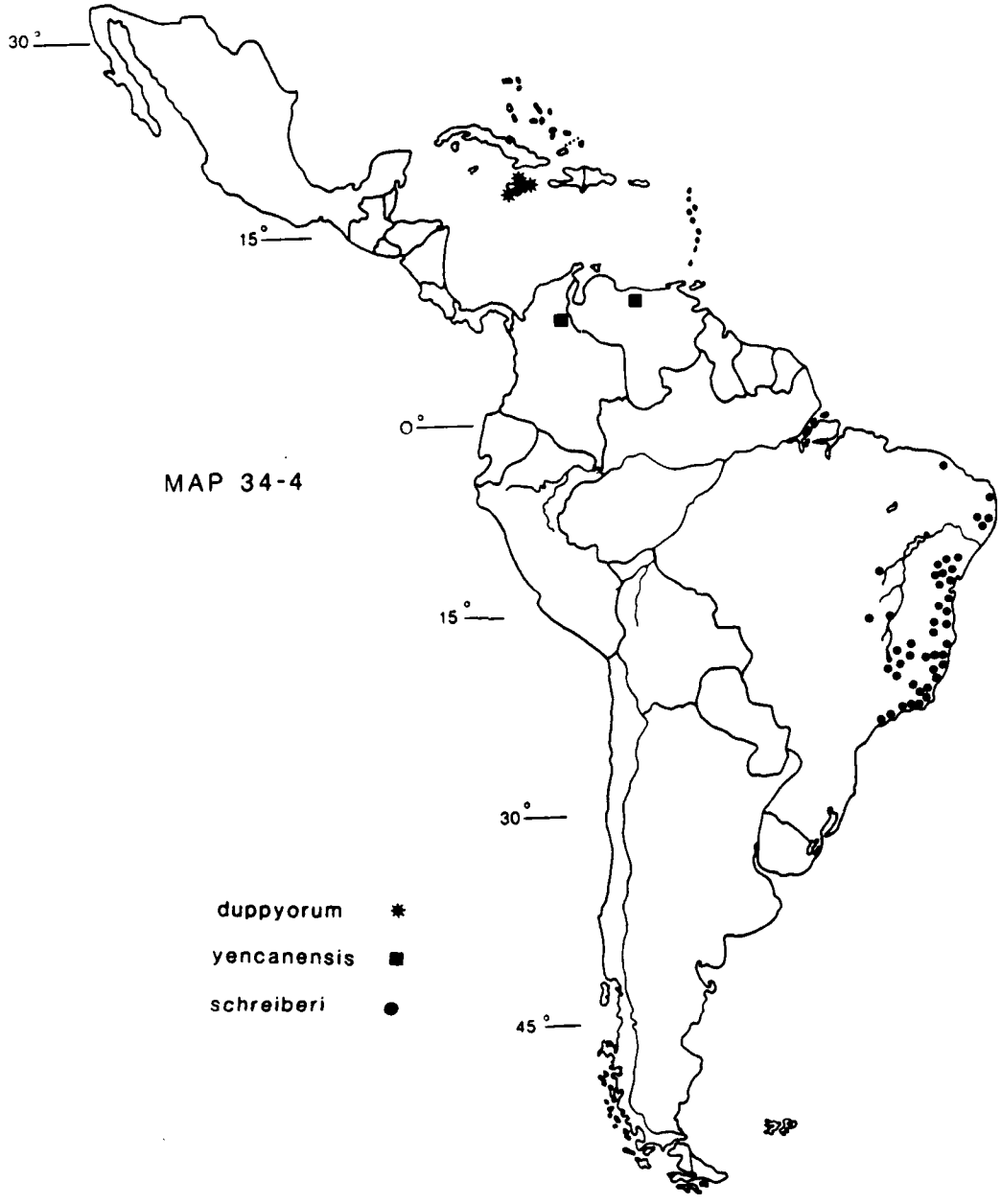

MAP 34-1


30°
15°
0°
15°
30°
45°
chiapanensis
cubensis
venezuelensis
oliveirai

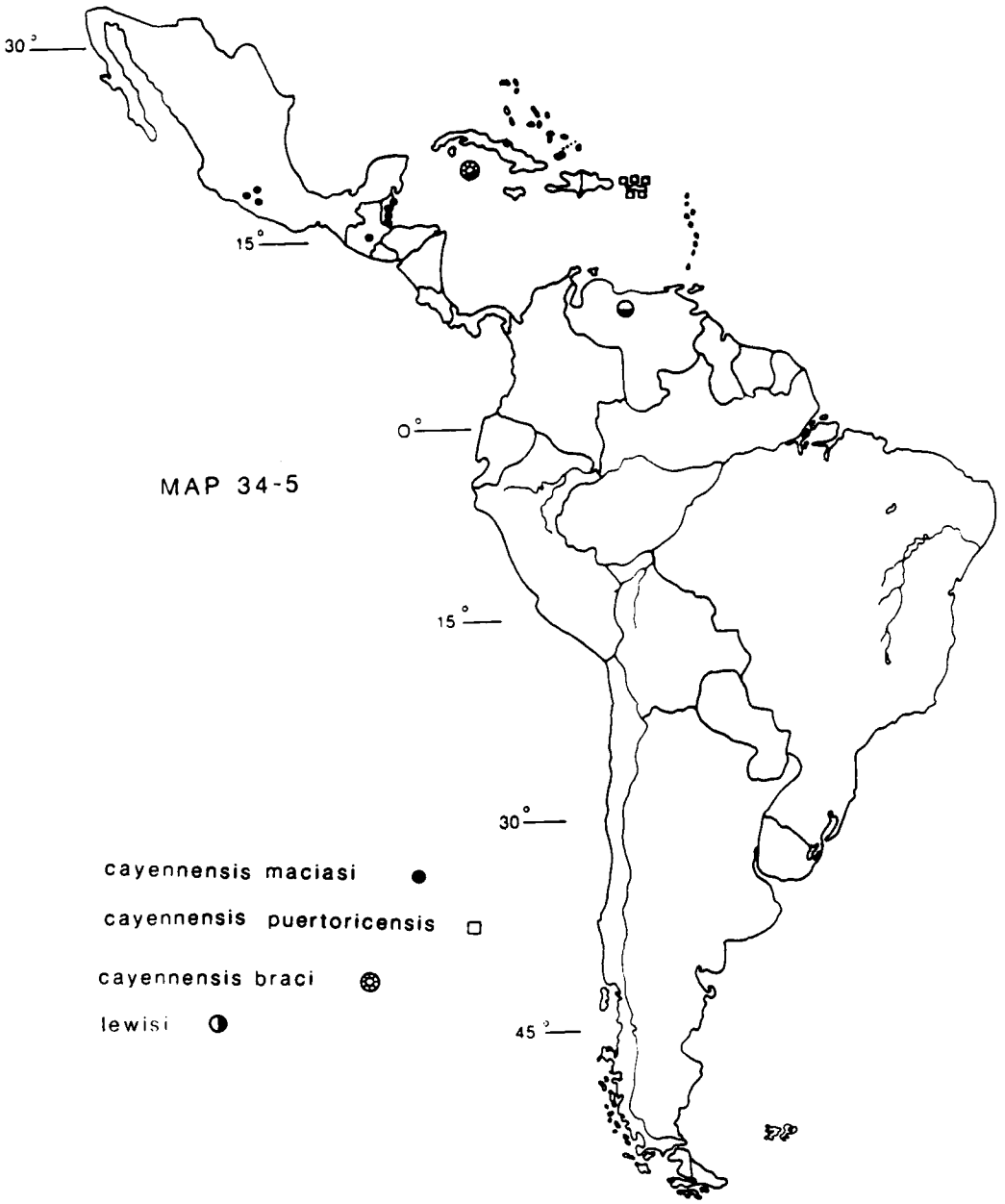
MAP 34-2

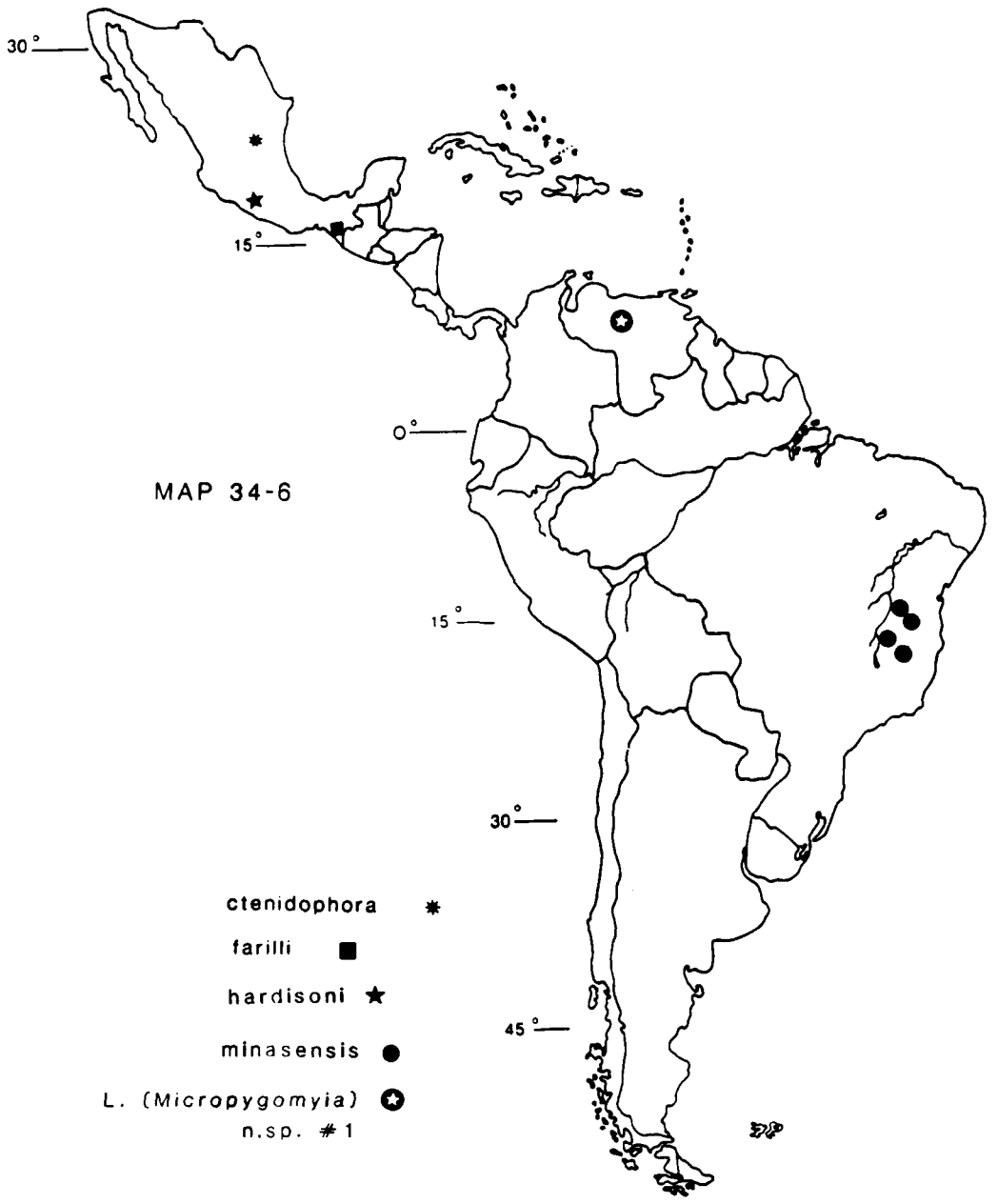



MAP 34-3




MAP 34-4


30°
15°
0°
15°
30°
45°
MAP 34-5
cayennensis maciasi
cayennensis puertoricensis
cayennensis braci
lewisi


30°
15°
0°
15°
30°
45°
ctenidophora
farilli
hardisoni
minasensis
L. (Micropygomyia) n.sp. #1

MAP 34-6


30°
15°
0°
15°
30°
45°
cayennensis cayennensis
cayennensis hispaniolae
cayennensis jamaicensis
cayennensis viequesensis

MAP 34-7

## 35. Lutzomyia Species Group Pilosa

Lutzomyia species group pilosa Theodor 1965: 194 (defined). Lewis et al. 1977: 325.

Lutzomyia subgenus Micropygomyia Barretto; Forattini 1971a: 101; 1973: 335 (in part).

Lutzomyia species group chassigneti Martins et al. 1978: 151 (defined).

Identification. Coloration dusky, scutum moderately pigmented. Antennal ascoids simple. Palpomere 5 longer than palps. 3 + 4. ♀ cibarium with 4-5 horizontal teeth in comb-like row; arch conspicuous only at sides. ♀ pharynx unarmed. Spermathecae with incomplete or complete annuli, it & associated ducts tubular; common duct short or absent. ♂ genitalia. Coxite with or without median-distal group of persistent setae. Style with 3 strong spines & small median or distal small seta; subterminal seta absent. Paramere simple. Lateral lobe extending to tip of paramere or slightly beyond.

The females in this species group cannot be separated by structural characteristics.

Medical Importance. Unknown; the species are not anthropophilic.

Key to males of the species group pilosa

1. Coxite with group of 15 or more persistent setae. ..... 2

   Coxite without persistent setae. ..... L. chassigneti (Pl. 35-1)

2. Coxite with basal-median group of 15-20 rigid setae; 3-4 shorter setae present at base of group. ..... L. mangabeirana (Pl. 35-1)

   Coxite with median-distal group of thinner setae & without shorter setae at base of group. ..... L. pilosa (Pl. 35-2)

Lutzomyia chassigneti (Floch & Abonnenc)

Plate 35-1

Phlebotomus chassigneti Floch & Abonnenc 1944a: 3 (♂, ♀, Baduel, Cayenne, French Guiana). Fairchild & Trapido 1950: 410 (mention). Floch & Abonnenc 1952: 69 (♂, ♀ figs., tax.).

Lutzomyia chassigneti: Theodor 1965: 194 (♀ figs.). Forattini 1971a: 101 (listed); 1973: 339 (figs., tax.). Lewis 1975a: 503 (mouthpart morphol.). Leger et al. 1977: 218 (French Guiana). Martins et al. 1978: 152 (refs., dist.). Ramirez-Perez et al. 1979: 264 (cf. to pilosa). Ryan 1986: 78 (mention). Lebbe et al. 1987: 29 (computer aided ident).

Distribution (Map 35-1). French Guiana (Leger et al. 1977; Martins et al. 1978); Brazil (♂♂, ♀♀, Labrea, Amazonas, D. Young).

Remarks. This species has not been previously reported in Brazil.

Lutzomyia pilosa (Damasceno & Causey)

Plate 35-2

Flebotomus pilosus Damasceno & Causey 1944: 342 (♂, Belém, Pará, Brazil). Barretto 1947: 219. Floch & Abonnenc 1952: 30 (♂ keyed).

Lutzomyia pilosa: Theodor 1965: 194 (♂ figs.). Forattini 1973: 343 (figs., tax.). Martins et al. 1978: 152 (refs., dist.). Young 1979: 231 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (Venezuela). Morales & Minter 1981: 97 (♀, probably pilosa, Colombia). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ramirez-Perez et al. 1982b: 58 (Tachira, Venezuela, ♂, ♀ figs.). Christensen et al. 1983: 466 (listed). Murillo & Zeledon 1985: 121 (figs., Costa Rica). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Geoffroy et al. 1986: 486 (French Guiana). Ryan 1986: 78 (♂, ♀ figs., Pará, Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 35-2). Costa Rica (Murillo & Zeledon 1985); Panama (Young 1979); Colombia (Young 1979; Morales & Minter 1981); French Guiana (Geoffroy et al. 1986); Brazil (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986); Trinidad (Aitken et al. 1968).

## Lutzomyia mangabeirana Martins, Falcão & Silva

Plate 35-1

Lutzomyia mangabeirana Martins, Falcão & Silva 1963: 342 (♂, ♀, Terreno do Padres, Roraima, Brazil). Theodor 1965: 194 (listed). Forattini 1971a: 101 (listed); 1973: 343 (♂, ♀ figs., tax.). Martins et al. 1978: 151 (♂, ♀ figs.). Ramirez Perez et al. 1979: 264 (mention).

Distribution (Map 35-1). Brazil (type locality).

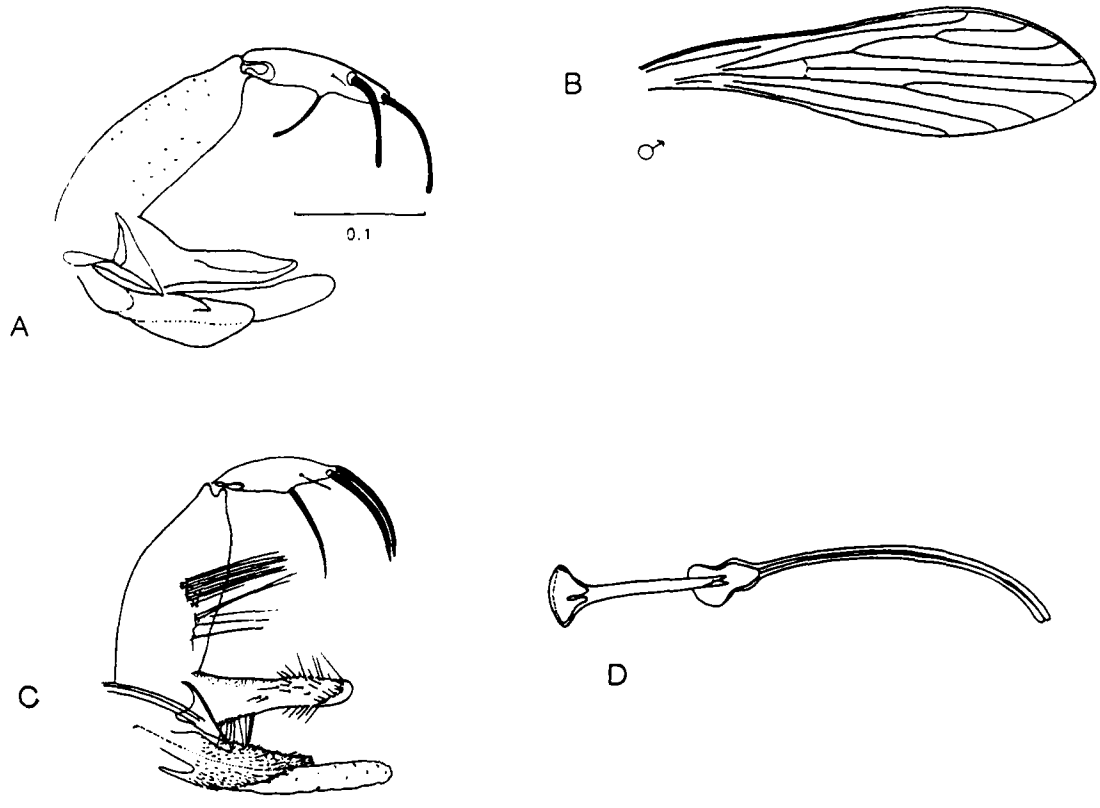



Plate 35-1

Lutzomyia chassigneti. A. Male terminalia, setae on paramere not shown; B. Male wing.

Lutzomyia mangabeirana. C. Male terminalia; D. Genital pump & filaments (after Martins et al. 1963).

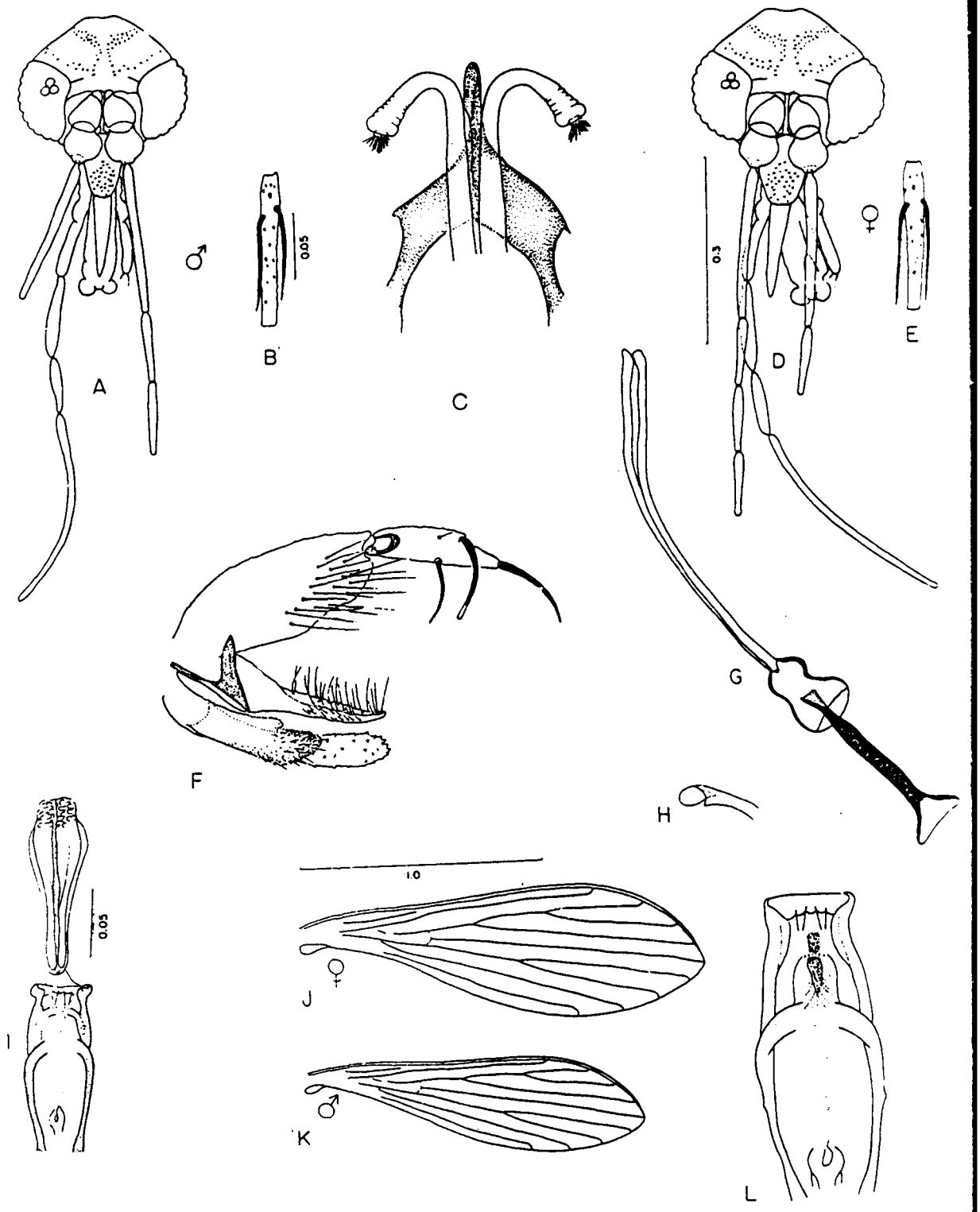
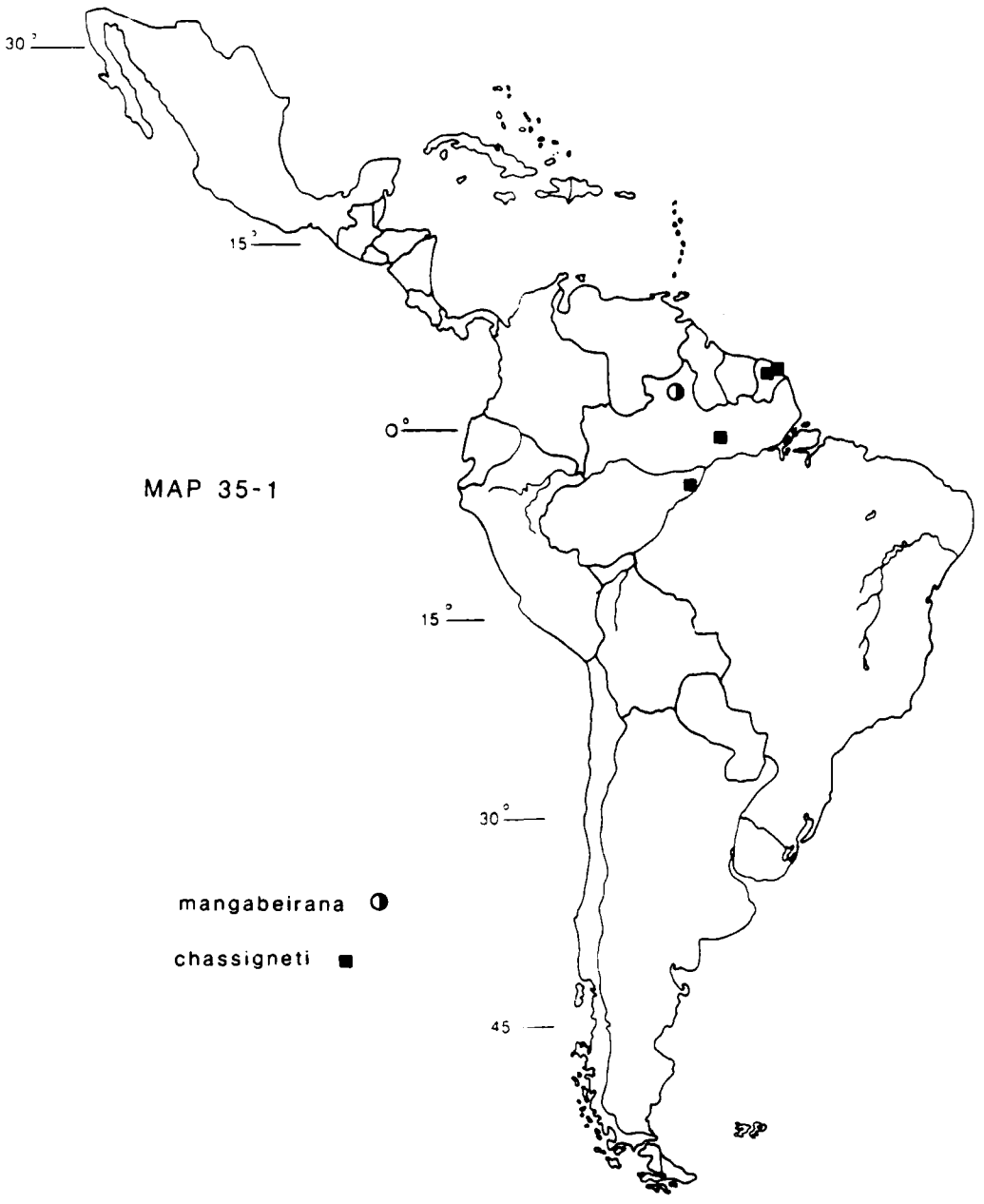



Plate 35-2

Lutzomyia pilosa. A. Male head, B. Male flagellomere II, C. Spermathecae, D. Female head, E. Female flagellomere II, F. Male terminalia, G. Genital pump & filaments, H. Tip of genital filament, I. Female cibarium & pharynx, J. Female wing, K. Male wing, L. Female cibarium (from Young 1979).




MAP 35-1




MAP 35-2

pilosa ★

## 36. *Lutzomyia* Species Group *Oswaldoi*

*Lutzomyia* subgenus *Helcocyrtomyia* Barretto 1962: 96. Martins et al. 1978: 68 (defined).

*Lutzomyia* species group *oswaldoi*: Theodor 1965: 187. Lewis et al. 1977: 325.

*Lutzomyia* subgenus *Trichopygomyia* (in part): Forattini 1971a: 101; 1973: 292 (in part).

*Identification*. Coloration dusky to dark, no completely pale species known. Antennal ascoids simple & often very short, barely reaching distal fourth of flagellomeres. Palpomere 5 longer that palp. 3. ♀ cibarium with 4 horizontal teeth, inwardly directed or not; arch complete or not pigment patch usually conspicuous. Pharynx with or without posterior spines. Spermathecae smooth walled & elongate or shorter with 1 or more complete or incipient annulations. ♂ *genitalia*. Coxite with or without persistent setae. Style with 5-6 spines (*L. rorotaensis* populations in parts of western Colombia have 4 spines); subterminal seta absent. Paramere simple, bifurcate or with median dorsal arm.

The species in this group correspond to those in the series *oswaldoi* of Martins et al. 1978 except that we include *L. quinquefer* and *L. fonsecai*. The latter, little-known species is provisionally placed in this group pending more information.

The status of some other described species, such as L. pratti, remains uncertain. We have examined large numbers of L. trinidadensis and L. rorotaensis but few or no specimens of the other taxa.

Medical Importance. Unknown; the females in this group are not anthropophilic.

Key to the Males of the Species Group Oswaldoi*

1. Paramere bifurcate or with dorsal arm. ..... 2
   Paramere simple. ..... 3

2. Paramere with relatively large dorsal arm bearing 20+ setae. Genital filaments shorter than 3X length of pump. ..... L. ramirezi (Pl. 36-1)
   Paramere with smaller, less clubbed dorsal arm bearing fewer than 10 setae. Genital filaments at least 3X length of pump. ..... L. appendiculata (Pl. 36-1)

3. Genital filament tips bifurcate. Style with median group of 3 spines inserted close together plus a subapical & apical spine. ..... L. breviducta (Pl. 36-1)
   Genital filament tips simple. Style with spines distributed otherwise. ..... 4

*The male of L. fonsecai remains unknown.

4. Paramere with subterminal acute projection on ventral margin. ..... L. zikani (Pl. 36-2)

Paramere without such a projection. ..... 5

5. Coxite with 4 or more spatulate or enlarged setae at or near middle of structure. ..... 6

Coxite without such setae. ..... 7

6. Genital filaments shorter than 3X length of pump. Coxite with fewer then 6 spatulate setae near middle. Paramere not markedly upturned. ..... L. borgmeirei (Pl. 36-2)

Genital filaments 3X length of pump or longer. Coxite with group of 6 or more strong setae. Paramere curved upwards. ..... L. quinquefer (Pl. 36-3)

7. Coxite with inner median group of 10 or more persistent setae. ..... 8

Coxite with median group of fewer setae or else lacking them entirely. ..... 11

8. Wing venation with beta longer than alpha. ..... 9

Wing venation with beta shorter than or equal to alpha. ..... 10

9. Coxite with compact tuft of setae. Genital filaments longer than 4X length of genital pump..... Lutzomyia sp. #2 of Araracuara (Pl. 36-4)

Coxite with diffuse group of setae. Genital filaments shorter than 4X length of pump. ..... L. longipennis (Pl. 36-4)

10. Coxite with inner group of 20+ setae occupying nearly all of middle third of structure. ..... L. quechua (Pl. 36-5)
L. rorotaensis (Pl. 36-6)*
Coxite with fewer persistent setae. ..... L. trinidadensis (Pl. 36-7)
L. goiana (Pl. 36-8)

11. Genital filaments 3X length of pump or longer. ..... 12
Genital filaments shorter than 3X length of pump. ..... 14

12. Wing venation with beta longer than alpha. Genital filaments 4X or more length of pump. ..... L. machupicchu (Pl. 36-8)
Wing venation with beta shorter than alpha. Genital filaments shorter than 4X length of pump. ..... 13

13. Lateral lobe shorter than 0.20 mm. ..... L. peresi (Pl. 36-9)
Lateral lobe longer than 0.20 mm. ..... L. capixaba (Pl. 36-10)

14. Coxite with fewer than 8 persistent setae. ..... 15
Coxite without persistent setae. ..... 17

15. Style with paired proximal spines, i.e., inserted more or less on same level. ..... 16
Style with isolated proximal spine. ..... L. ferreirana (Pl. 36-11)

---

*Some males in western Colombia have but 4 spines on their styles (Young 1979).

16. Wing venation with delta nil. ..... L. pratti (Pl. 36-11)

Wing venation with delta positive. ..... L. oswaldoi (Pl. 36-11)

17. Paramere more slender, gradually narrowing towards its tip. Lateral lobe extending slightly beyond tip of paramere... L. pusilla (Pl. 36-12)

Paramere broader, slightly clubbed apically. Lateral lobe extending well beyond tip of paramere. ..... L. alphabetica (Pl. 36-12)

Key to the Females of the Species Group oswaldoi*

1. Spermathecae smooth-walled & tubular, its length greater than 4X maximum width; without annulations. ..... 2

Spermathecae otherwise. ..... 3

2. Pharynx relatively slender throughout & with about 8 transverse rows of small spines at posterior end. ..... L. goiana (Pl. 36-8)

Pharynx indented on each side near middle of structure, much wider posteriorally & with numerous strong spines.

..... L. trinidadensis (Pl. 36-7)

3. Spermathecae subsperical but constricted basally (light bulb shape) sometimes with a single collar-like annulation at base.

..... L. fonsecai (Pl. 36-10)

L. capixaba (Pl. 36-10)

---

*The females of L. appendiculata, L. breviducta, L. ferreirana, L. machupicchu and L. pratti are undescribed.

Spermathecae subspherical or tubular with 2 or more annulations. ... 4

4. Spermathecae tubular, its length about 4X maximum width; terminal annulation longer than wide, apical half narrowing to terminal knob. ..... L. pusilla (Pl. 36-12)
Spermathecae otherwise. ..... 5

5. Spermathecae with basal & terminal annulations subequal in width; 2-3 annulations between these subequal in width but smaller. ..... L. alphabetica (Pl. 36-12)
Spermathecae with all annulations subequal in width or else terminal annulation larger than others. ..... 6

6. Cibarium with sclerotized slender "hump" between inner pair of horizontal teeth. ..... 7
Cibarium without such a structure. ..... 8

7. Spermathecae with 9 or more incomplete or complete annulations; slender throughout. ..... L. peresi (Pl. 36-9)
Spermathecae with 6 or fewer annulations; terminal annulation much larger than others. ..... L. oswaldoi (Pl. 36-11)

8. Spermathecae subequal in width, terminal annulation not enlarged or suboval; individual ducts very thin & about 10X length of spermathecae. ..... L. ramirezi (Pl. 36-1)
Spermathecae with enlarged, suboval terminal annulation; individual sperm ducts wider & shorter than 10X length of spermathecae. ..... 9

9. Spermathecae with 3-4 annulations. Pharynx with numerous posterior spines. ..... L. borgmeirai (Pl. 36-2)

Spermathecae with 6 or more incomplete or complete annulations. Pharynx unarmed or with only a few barely discernible spines. ..... 10

10. Cibarium with horizontal teeth pointing to pharynx, not inwardly directed. ..... L. zikani (Pl. 36-2)

L. longipennis (Pl. 36-4)

Cibarium with inner and/or outer pair of horizontal teeth slanted inwards. ..... Lutzomyia sp. #2 of Araracuara

L. quechua (Pl. 36-5)

L. quinquefer (Pl. 36-3)

L. rorotaensis (Pl. 36-6)

## Lutzomyia ramirezi Martins, Falcao, Silva & Miranda

Plate 36-1

Lutzomyia ramirezi Martins, Falcao, Silva & Miranda 1982: 417 (♂, ♀, Morro do Chapéu, Minas Gerais, Brazil).

Distribution (Map 36-1). Brazil (type locality).

Remarks. The placement of this species in the oswaldoi species group is provisional. The female has an armed pharynx, like some others in the group, but the spermathecae and thin individual ducts resemble those of several females in the subgenus Lutzomyia (Martins et al. 1982).

## Lutzomyia appendiculata Martins, Falcão & Silva

Plate 36-1

Lutzomyia appendiculata Martins, Falcao & Silva 1961b: 297 (♂, Gruta da Pedreira, Minas Gerais, Brazil). Theodor 1965: 187 (listed). Forattini 1971a: 102 (listed); 1973: 302 (♂ fig.). Martins et al. 1978: 70 (refs., dist.)

Distribution (Map 36-1). Brazil (type locality).

## Lutzomyia breviducta (Barretto)

Plate 36-1

Phlebotomus breviductus Barretto 1951b: 146 (♂, Alegre, Espirito Santo, Brazil). Fairchild & Hertig 1961b: 250 (mention).

Lutzomyia breviducta (or breviductus): Martins et al. 1961b: 299 (cf. to appendiculata). Theodor 1965: 187 (listed). Forattini 1973: 302 (♂ fig.). Martins et al. 1978: 70 (refs., dist.).

Distribution (Map 36-2). Brazil (type locality).

## Lutzomyia zikani (Barretto)

Plate 36-2

Phlebotomus zikani Barretto 1950b: 143 (♂, ♀, Alegre, Espirito Santo, Brazil). Sherlock & Alencar 1959: 122 (cf. to pelloni). Ortiz & Alvarez 1963b: 312 (listed).

Lutzomyia zikani: Martins et al. 1962c: 85 (listed). Barretto 1962: 96. Theodor 1965: 187. Forattini 1973: 325 (♂, ♀ figs., tax.). Martins et al. 1978: 75 (refs., dist.).

Distribution (Map 36-3). Brazil (type locality).

## Lutzomyia borgmeieri Martins, Falcao & Silva

Plate 36-2

Lutzomyia borgmeirei Martins, Falcao & Silva 1972b: 497 (♂, ♀, Mata do Barreiro de Cima, Belo Horizonte, Minas Gerais, Brazil). Martins et al. 1978:70 (refs., dist.).

Distribution (Map 36-1). Brazil (Martins et al. 1978).

## Lutzomyia quinquefer (Dyar)

Plate 36-3

Phlebotomus quinquefer Dyar 1929: 114 (♂, Iguazu Falls, Missiones, Argentina). Fairchild & Hertig 1957: 326 (♂ fig., keyed, refs.). Lucena & Almeida 1965: 295 (♂, ♀).

Flebotomus quinquefer: Barretto 1947a: 220 (full refs.).

Flebotomus rickardi: Costa Lima 1936: 288 (♂, Crato, Ceara, Brazil). Fairchild & Hertig 1957: 332 (as synonym of quinquefer).

Lutzomyia quinquefer: Martins et al. 1961b: 297 (mention). Forattini 1973: 266 (♂, ♀ figs., tax.). Lewis 1975a: 501 (mouthpart morphol.). Martins et al. 1978: 80 (refs., dist., ♀ figs.). Mayrink et al. 1979: 131 (coll. data, Brazil).

Distribution (Map 36-4). Brazil; Argentina (Martins et al. 1978); Bolivia (♂♂, ♀♀, Rurrenbaque, Beni, rock tunnel, 1978, J. Velasco).

Remarks. Lutzomyia quinquefer clearly belongs in the oswaldoi species group. The female cibarium, male terminalia, ascoids and palpomeres are diagnostic. Its inclusion with members of the subgenus Helcocyrtomyia, series peruensis (Martins et al. 1978) cannot be justified when all character states are considered. Deane & Deane (1957) believe that females feed on lizards.

Lutzomyia quinquefer has not been reported previously from Bolivia.

## Lutzomyia species no. 2 of Araracuara

Plate 36-4

Lutzomyia sp. no. 2 of Araracuara Morales & Minter 1981: 106 (♂, ♀, Araracuara, Caqueta, Colombia).

Distribution (Map 36-5). Colombia (Morales & Minter 1981).

Remarks. This informally named taxon appears to be distinct from others in the oswaldoi species group but we have not closely examined males or females.

## Lutzomyia longipennis (Barretto)

Plate 36-4

Flebotomus longipennis Barretto 1946c: 427 (♂, Corumbá, Goias, Brazil).

Lutzomyia longipennis: Martins et al. 1962c: 390 (♂, ♀ figs.). Forattini 1973: 307 (figs., tax.). Martins et al. 1978: 71 (figs., refs., dist.). Arias & Frietas 1982: 404 (Acre, Brazil). Ryan 1986: 73 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 36-6). Brazil (Martins et al. 1978; Arias & Freitas 1982; Ryan 1986).

Lutzomyia quechua Martins, Llanos & Silva

Plate 36-5

Lutzomyia quechua Martins, Llanos & Silva 1975c: 646 (♂, ♀, Rio Chuillape, Quillabamba, Cuzco, Peru). Llanos et al. 1975b: 671 (Peru). Martins et al. 1978: 80 (dist.).

Distribution (Map 36-7). Peru (Martins et al. 1978).

Lutzomyia rorotaensis (Floch & Abonnenc)

Plate 36-6

Phlebotomus rorotaensis Floch & Abonnenc 1944e: 4 (♂, ♀, Rorota, French Guiana).

Lutzomyia rorotaensis: Martins et al. 1961b: 300 (mention). Leger et al. 1977: 222 (French Guiana). Martins et al. 1978: 73 (refs., dist.). Young 1979: 225 (full refs., figs.). Lainson et al. 1979: 240 (negative for flagellates, Pará, Brazil). Biancardi et al. 1982: 168 (Rondonia, Brazil). Ready et al. 1983: 780 (Brazil). Geoffroy 1984: 257 (gyandromorph, fig., French Guiana). Arias et al. 1985: 1101 (natural flagellate infections, Brazil). Young et al. 1985: 145 (Peru). Ready et al. 1986: 27 (Brazil). Dias et al. 1986a: 218 (cf. to peresi). Geoffroy et al. 1986: 486 (tree preference study, French Guiana). Ryan 1986: 76 (♂, ♀ figs., Pará, Brazil). Lebbe et al 1987: 29 (computer aided ident.).

Lutzomyia oswaldoi: Leger et al. 1977: 218 (? misident., French Guiana).

Distribution (Map 36-1). Panama; Colombia (Young 1979); French Guiana (Floch & Abonnenc 1952; Leger et al. 1977; Geoffroy et al. 1986); Brazil (Martins et al. 1978; Biancardi et al. 1982; Ryan 1986). Peru (Young et al. 1985).

Remarks. Forattini (1973) considers L. rorotaensis to be conspecific with L. venezuelensis and L. oswaldoi but this decision is not supported by structural differences (Young 1979; Martins et al. 1978).

Females of L. rorotaensis feed on cold blooded vertebrates in Panama (Tesh et al. 1971a) and breeding sites include the open forest floor in that country (Rutledge & Ellenwood 1975a).

Leger et al. (1977) list L. oswaldoi from French Guiana but the specimens are probably conspecific with L. rorotaensis.

In Pará, Brazil, trypanosomes were found in L. rorotaensis captured while feeding on the gecko, Thecadactylus rapicaudus (Lainson & Shaw 1979).

## Lutzomyia trinidadensis (Newstead)

Plate 36-7

Phlebotomus trinidadensis Newstead 1922: 4 (♂, ♀, Trinidad). Fairchild & Hertig 1948a: 253 (refs., figs., tax.).

Phlebotomus yucatanensis Galliard 1934: 1 (♂, ♀, near Chichen Itza, Yucatan, Mexico). Fairchild & Hertig 1948a: 255 (as synonym of trinidadensis).

Phlebotomus yucatanensis var. baduelensis Floch & Abonnenc 1941a: 4 (♂, Baduel, French Guiana). Fairchild & Hertig 1948a: 225 (as synonym of trinidadensis).

Phlebotomus villelai Mangabeira 1942a: 196 (♂, Cleará & Pará, Brazil). Barretto 1946b: 527 (as synonym of baduelensis). Fairchild & Hertig 1948a: 255 (as synonym of trinidadensis).

Phlebotomus baduelensis Floch & Abonnenc 1944e: 1 (♂, ♀, French Guiana). Fairchild & Hertig 1948a: 255 (as synonym of trinidadensis. Floch & Abonnenc 1952: 163 (♂, ♀).

Lutzomyia trinidadensis: Martins et al. 1961a: 300 (mention) Leger et al. 1977: 218 (French Guiana). Ramirez Perez et al. 1978: 52 (figs., Venezuela). Martins et al. 1978: 73 (refs.,dist.). Young 1979: 227 (refs., dist., figs.). Scorza et al. 1979: 35 (biting habits). Feliciangeli 1980: 246 (keyed). Ramirez Perez et al. 1981: 124 (Venezuela); 1982a: 14 (♂, ♀ figs., Venezuela); 1982b: 58 (♂, ♀ figs., Venezuela). Biancardi et al. 1982: 168 (Rondonia, Brazil). Arias & Frietas 1982: 401 (Acre, Brazil). Young & Rogers 1984: 610 (Ecuador). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Murillo & Zeledón 1985: 117 (♂, ♀ figs., Costa Rica). Ryan 1986: 77 (figs., Brazil). Dias et al. 1986a: 218 (cf. to peresi). Feliciangeli 1987a: 122; 1987b: 127 (coll. data, Venezuela). Lebbe et al. 1987:29 (computer

aided ident.). Ryan et al. 1987a: 356 (nat. infection flagellates, Pará, Brazil).

Lutzomyia cruciata (not cruciatus Coq.): Zeledón et al. 1982: 276 (Honduras).

Distribution (Map 36-3). Mexico; Belize (Martins et al. 1978); Honduras (Fairchild & Hertig 1959; Zeledón et al. 1982); Nicaragua (Fairchild & Hertig 1959); Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979); Ecuador (Young & Rogers 1984); Peru (Martins et al. 1978); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978, 1981, 1982a,b; Feliciangeli 1987a,b); French Guiana (Leger et al. 1977; Martins et al. 1978); Trinidad (Aitken et al. 1968); Brazil (Martins et al. 1978; Biancardi et al. 1982; Arias & Freitas 1982; Ryan 1986). Bolivia (Martins et al. 1978).

Remarks. Lutzomyia trinidadensis has the widest geographic distribution of the oswaldoi group species. Females feed on cold blooded vertebrates (Tesh et al. 1971a) and have been found naturally infected with flagellates, mostly trypanosomes, and filarial worms (Williams 1976a & Ryan et al. 1987c). There are reports of L. trinidadensis collected on human bait (e.g., Scorza et al. 1979), but the species is regarded as nonanthropophilic.

Hanson (1968) collected larvae of L. trinidadensis in Panama from soil samples between buttressed roots of trees. The adults commonly rest on tree trunks and also have been found resting inside houses where, presumably, they feed on geckoes and other lizards.

## Lutzomyia goiana Martins, Falcao & Silva

Plate 36-8

Lutzomyia goiana Martins, Falcao & Silva 1962b: 383 (♂, ♀, Sitio d'Abadia, Goias, Brazil). Forattini 1971: 102 (listed). Lewis 1975a: 502 (mouthpart morphol.). Martins et al. 1978: 71 (refs., dist.). Arias et al. 1985: 1101 (negative for flagellates, Brazil). Galati et al. 1985: 261 (Mato Grosso do Sul, Brazil). Dias et al 1986a: 218 (cf. to peresi).

Lutzomyia trinidadensis: Forattini 1973: 321 (in part).

Distribution (Map 36-2). Brazil (Martins et al. 1978; Galati et al. 1985).

Remarks. Forattini (1973) treats L. goiana as a junior synonym of L. trinidadensis, but the female pharynx of L. goiana consists of fewer spines and is more slender than that of L. trinidadensis. The males appear to be morphologically inseparable.

Lutzomyia machupicchu Martins, Llanos & Silva

Plate 36-8

Lutzomyia machupicchu Martins, Llanos & Silva 1975c: 652 (♂, Machupicchu, Cuzco, Peru). Llanos et al. 1975b: 670 (Peru). Martins et al. 1978: 71. Llanos 1981: 183 (listed).

Distribution (Map 36-8). Peru (type locality).

Remarks. One of us (D.G.Y.) was unable to locate the male holotype of L. machupicchu in the collection of the National Institute or Health, Lima, in 1988. We have not seen specimens referable to this species.

Lutzomyia peresi (Mangabeira)

Plate 36-9

Flebotomus peresi Mangabeira 1942a: 190 (♂, Januária, Minas Gerais, Brazil). Barretto 1947a: 217 (refs.); 1950a: 112 (♂ keyed).

Lutzomyia peresi: Barretto 1962: 96 (listed). Forattini 1973: 314 (♂ fig.). Martins et al. 1978: 72 (in part, dist.). Dias et al. 1986a: 215 (♂, ♀, tax., dist., figs.); 1986b: 395 (cf. to pusilla).

Distribution (Map 36-9). Brazil (Dias et al. 1986a); Bolivia (2 ♀♀, Rurrenabaque, Beni, 1978, J. Velasco).

Remarks. Records of L. peresi from Brazilian localities other than in Goias, Minas Gerais, Mato Grosso do Sul and Mato Grosso States, Brazil, are erroneous and represent L. pusilla (Dias et al. 1986a,b). The presence of this species in Ceará State, Brazil (Alencar 1959), and in Pernambuco, Brazil (Lucena & Almeida 1965), is questionable (Dias et al. 1986b). Lutzomyia peresi has not previously been reported in Bolivia. Two females from there have tiny, almost indiscernible, spines in the pharynx.

## Lutzomyia capixaba Dias, Falcao, Silva & Martins

Plate 36-10

Lutzomyia capixaba Dias, Falcao, Silva & Martins 1987: 193 (♂, ♀, Conquista, Espirito Santo, Brazil).

Distribution (Map 36-10). Brazil (Dias et al. 1987).

## Lutzomyia fonsecai (Costa Lima)

Plate 36-10

Phlebotomus fonsecai Costa Lima 1932: 49 (♀, Gruta de Inscripciones, Carmen, Santa Cruz, Bolivia).

Lutzomyia fonsecai: Theodor 1965: 196 (listed). Forattini 193: 352 (♀ fig.). Martins et al. 1978: 168 (listed).

Distribution (Map 36-9). Bolivia (type locality).

Remarks. This species was inadequately described and illustrated from the female and no additional specimens have been taken at, or near, the type locality. Seven females represented the type material.

From the wing and spermathecae illustrations and palpal measurements (Costa Lima 1932), it is likely that this species belongs in the oswaldoi species group. The spermathecae resemble those of L. capixaba in shape but the sperm ducts of L. fonsecai appear to be shorter and broader.

Lutzomyia ferreirana (Barretto, Martins & Pellegrino)

Plate 36-11

Sergentomyia ferreirana Barretto, Martins & Pellegrino 1956: 52 (♂, Jampruca, Minas Gerais, Brazil). Barretto et al. 1958: 187 (repeat of original descript.).

Lutzomyia ferreirana: Barretto 1962: 96 (listed). Forattini 1973: 306 (♂ fig., tax.). Martins et al. 1978: 70 (refs., dist.). Mayrink et al. 1979: 131 (Minas Gerais, Brazil).

Distribution (Map 36-8). Brazil (Martins et al. 1978).

Remarks. The female of L. ferreirana has been discovered in Brazil but it remains undescribed (Martins et al. 1978; Mayrink et al. 1979).

## Lutzomyia pratti (Vargas & Najera)

Plate 36-11

Phlebotomus pratti Vargas & Najera 1951a: 19 (♂, Iguala, Guerrero, Mexico).

Lutzomyia pratti: Barretto 1962: 96 (listed). Forattini 1973: 317 (♂ fig.). Martins et al. 1978: 72 (dist.).

Distribution (Map 36-2). Mexico (Martins et al. 1978).

Remarks. This species has been mentioned several times in the literature (e.g., Vargas 1981), but it remains poorly known from the male only. We have not examined material of L. pratti.

## Lutzomyia oswaldoi (Mangabeira)

Plate 36-11

Flebotomus oswaldoi Mangabeira 1942a: 190 (♂, Timbaúbas, Russas, Cleará, Brazil); 1942e: 288 (♀ & immatures). Barretto 1947a: 216 (refs., synonomy).

Phlebotomus oswaldoi: Barretto 1950b: 145 (cf. to zikani). Floch & Abonnenc 1950b: 8 (tax.). Deane & Deane 1957: 226 (coll. data, Ceará, Brazil). Forattini 1959: 160 (Amapa, Brazil). Carneiro & Sherlock 1964: 315 (pupa keyed). Sherlock & Pessoa 1964: 332 (habits, Brazil). Mangabeira 1969: 18 (habits, figs., Brazil).

Lutzomyia oswaldoi: Martins et al. 1961b: 299 (cf. to appendiculata). Theodor 1965: 187 (♂, ♀ figs.). Forattini 1973: 312 (in part, figs., tax.). Martins et al. 1978: 71 (refs., dist.). Lainson et al. 1983: 329 (lizard feeding, Pará, Brazil). Ryan et al. 1984: 547 (Pará, Brazil). Dias et al. 1986a: 218; 1986b: 196 (cf. to oswaldoi group spp.). Ryan 1986: 74 (♂, ♀ figs., Pará, Brazil).

Distribution (Map 36-5). Brazil (Martins et al. 1978; Ryan 1986).

Remarks. Deane & Deane (1957) reported that females of L. oswaldoi feed on lizards.

## Lutzomyia pusilla Dias, Martins, Falcao & Silva

Plate 36-12

Lutzomyia pusilla Dias, Martins, Falcão & Silva 1986b: 395 (♂, ♀, Serra do Navio, Amapá, Brazil).

Phlebotomus peresi (not peresi Mangabeira): Floch & Abonnenc 1944e: 7 (♂, French Guiana). Damasceno et al. 1949: 830 (Pará, Brazil). Barretto 1951: 222 (Amazonas & Pará, Brazil). Floch & Abonnenc 1952: 170 (♂ figs., tax., French Guiana). Lucena & Almeida 1965: 257 (Pernambuco, Brazil).

Phlebotomus sp. de Saül Floch & Abonnenc 1944e: 8 (♀, French Guiana); 1952: 186 (♀ figs.). Leger et al. 1977: 218 (French Guiana).

Lutzomyia peresi (not peresi Mangabeira). Leger et al. 1977: 222 ( French Guiana). Martins et al. 1978: 72 (in part, dist., refs.). Ryan 1986: 75 (♂ fig., Pará Brazil). Lebbe et al. 1987: 29 (computer aided ident.).

Distribution (Map 36-11). French Guiana (Floch & Abonnenc 1952; Leger et al. 1977); Brazil (Dias et al. 1986b; Ryan 1986).

Remarks. Dias et al. (1986a,b) discussed previous misidentifications of this species as L. peresi; not peresi Mangabeira. Alencar (1959) reported L. peresi from Ceará (see Dias et al. 1986a). We have not seen this publication, but the specimen(s) probably represent L. pusilla.

## Lutzomyia alphabetica (Fonseca)

Plate 36-12

Flebotomus alphabeticus Fonseca 1936: 327 (♀, Horto Florestal, Serra da Cantareira, São Paulo, Brazil). Barretto 1943: 703 (variation; 1947a: 183 (refs.).

Phlebotomus alphabeticus Coutinho & Barretto 1940b: 193 (♂, ♀). Barretto 1941a: 398 (immatures).

Lutzomyia alphabetica: Martins et al. 1961b: 299 (cf. to appendiculata). Forattini 1973: 300 (figs., tax.). Martins et al. 1978: 161 (refs., dist.).

Distribution (Map 36-7). Brazil; Argentina (Martins et al. 1978).

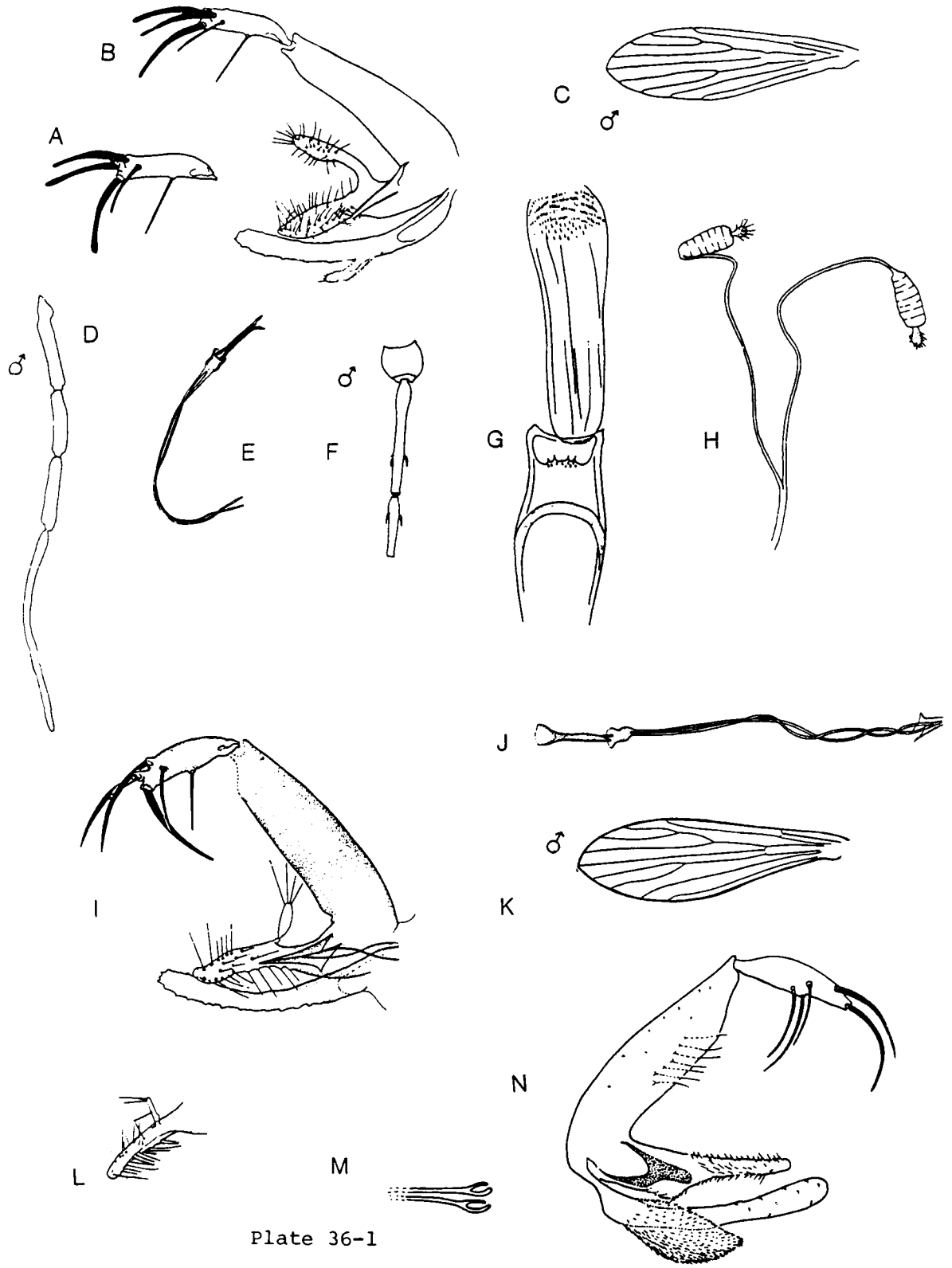



Plate 36-1

Lutzomyia ramirezi. A. Male style; B. Male terminalia; C. Male wing; D. Male palpus; E. Genital pump & filaments; F. Male antenna, scape & basal flagellomeres; G. Female cibarium & pharynx; H. Spermathecae (figs. from Martins et al. 1982).

Lutzomyia appendiculata. I. Male terminalia; J. Genital pump & filaments; K. Male wing; L. Paramere (figs. from Martins et al. 1961b).

Lutzomyia breviducta. M. Tips of genital filaments; N. Male terminalia (figs. from Barretto 1951b).

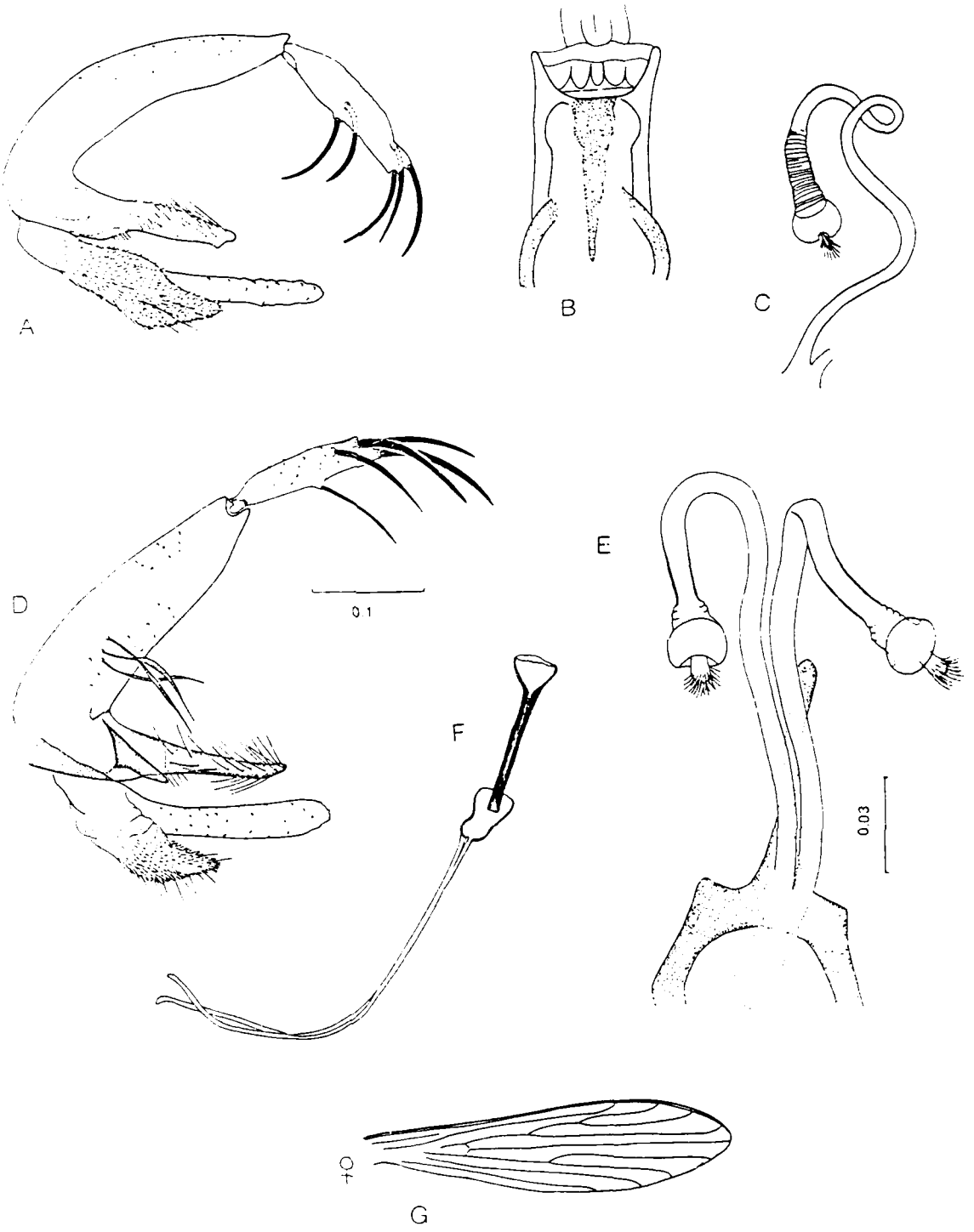



Plate 36-2

Lutzomyia zikani. A. Male terminalia; B. Female cibarium; C. Spermatheca (figs. from Barretto 1950b).

Lutzomyia borgmeirai. D. Male terminalia; E. Spermathecae; F. Genital pump & filaments; G. Female wing.

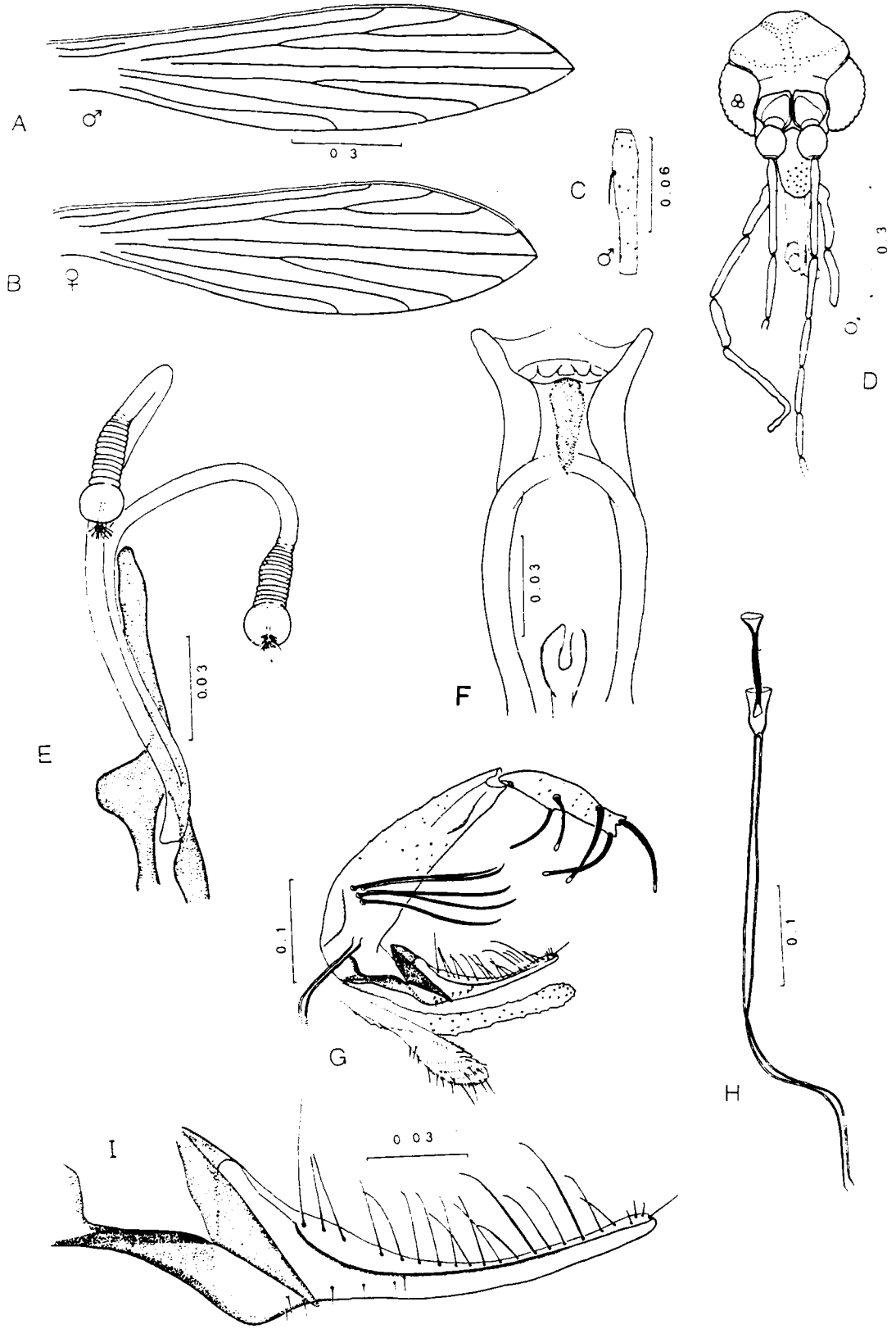



Plate 36-3

Lutzomyia quinquefer. A. Male wing; B. Female wing; C. Male flagellomere II; D. Male head; E. Spermathecae; F. Female cibarium; G. Male terminalia; H. Genital pump & filaments; I. Paramere & aedeagus.

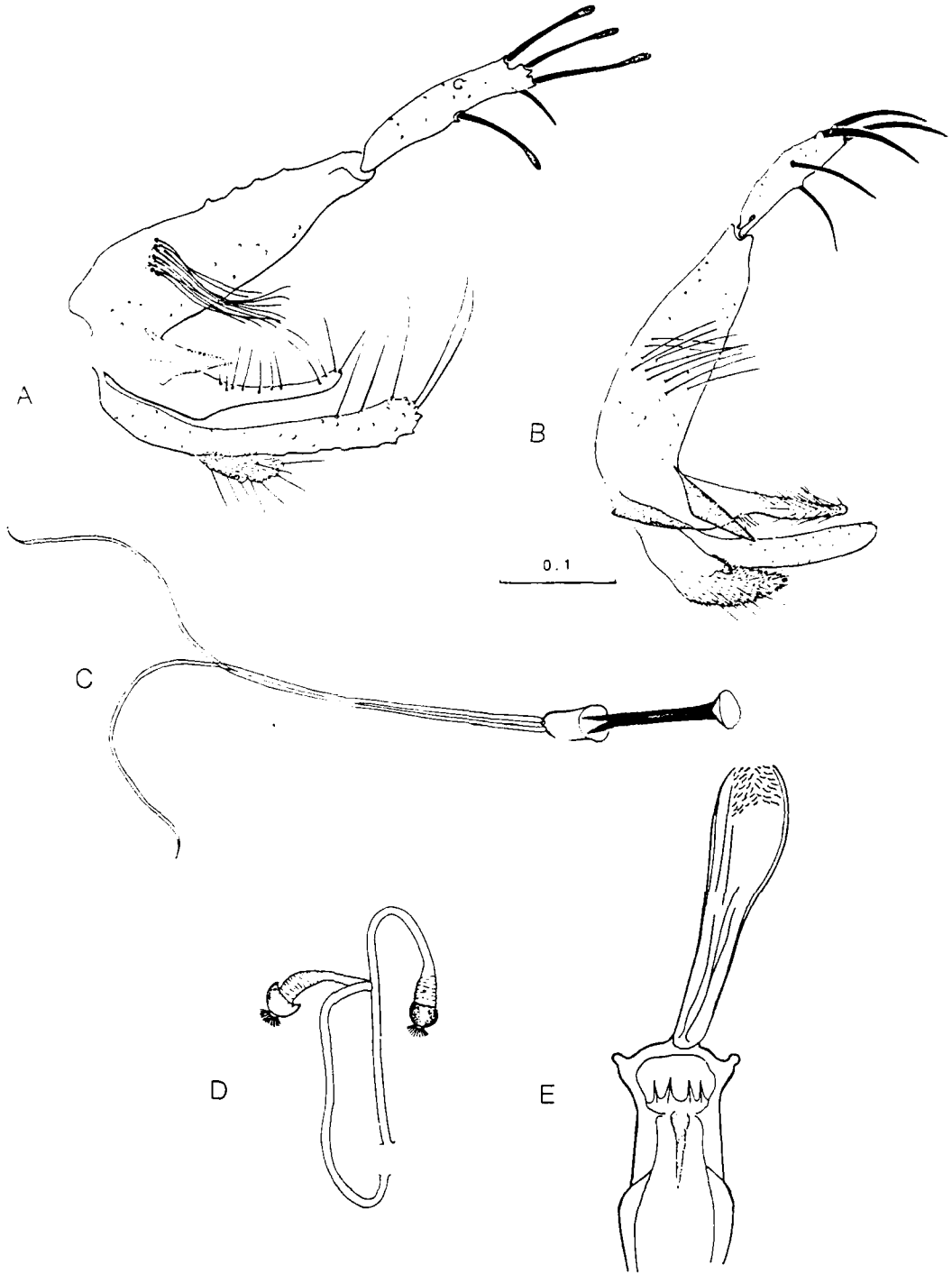



Plate 36-4

Lutzomyia sp. #2 of Araracuara. A. Male terminalia (after Morales & Minter 1981).

Lutzomyia longipennis. B. Male terminalia; C. Genital pump & filaments; D. Spermathecae; E. Female cibarium (figs. D & E after Martins et al. 1962c).

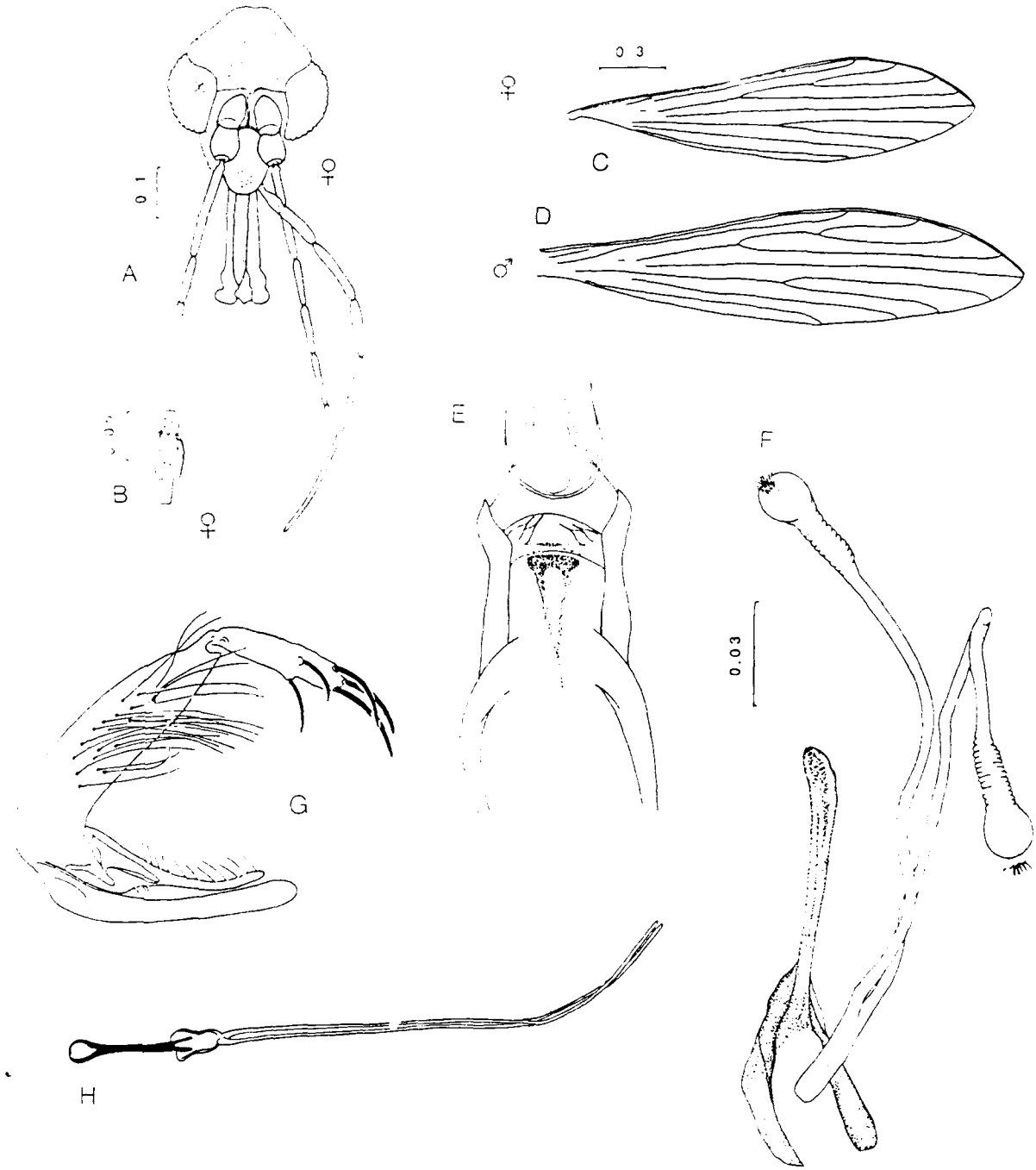



Plate 36-5

Lutzomyia quechua. A. Female head; B. Female flagellomere II; C. Female wing; D. Male wing; E. Female cibarium; F. Spermathecae; G. Male terminalia; H. Genital pump & filaments (male figs. after Martins et al. 1975c).

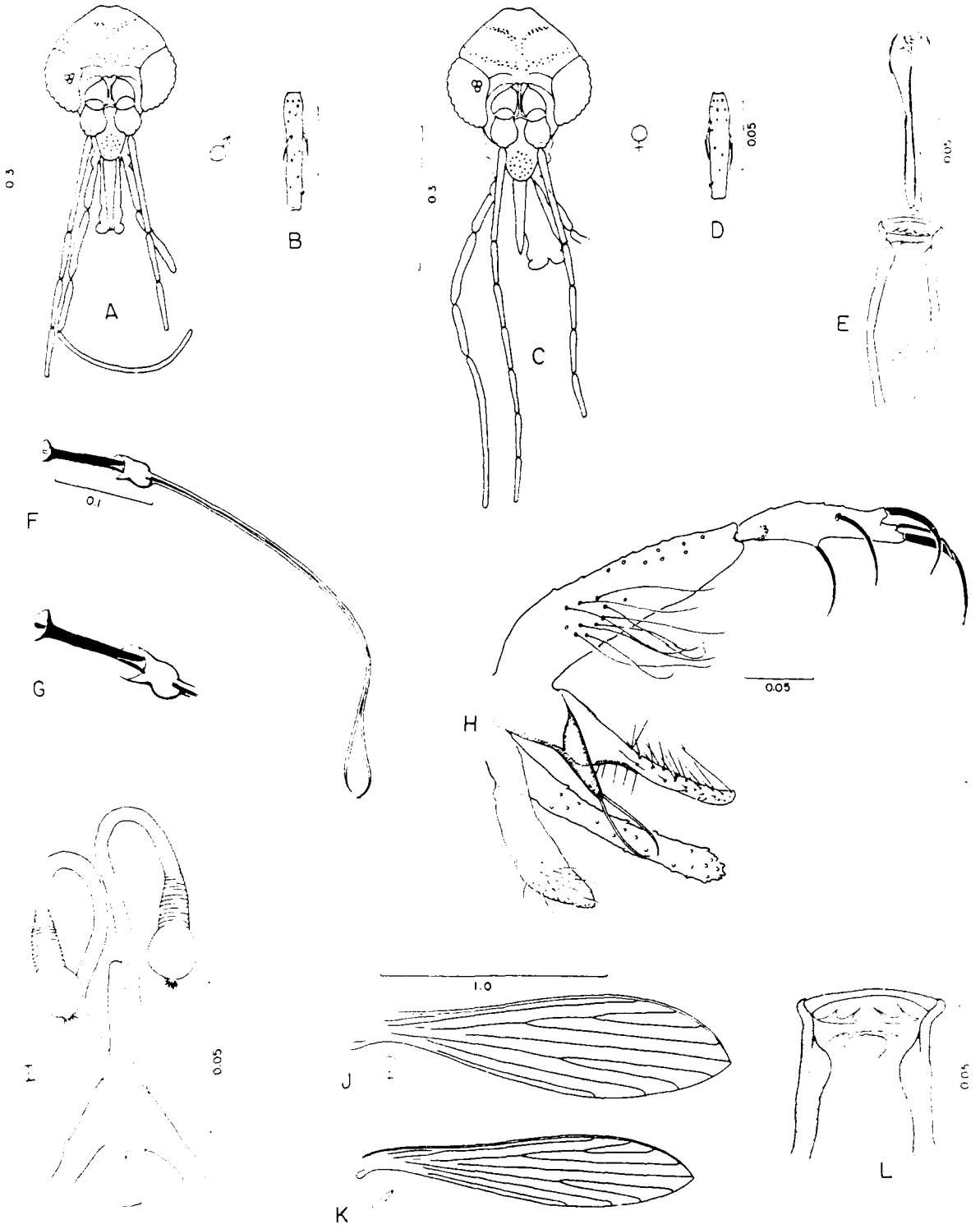



Plate 36-6

Lutzomyia rorotaensis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Genital pump; H. Male terminalia; I. Spermathecae; J. Female wing; K. Male wing; L. Female cibarium (figs. from Young 1979).

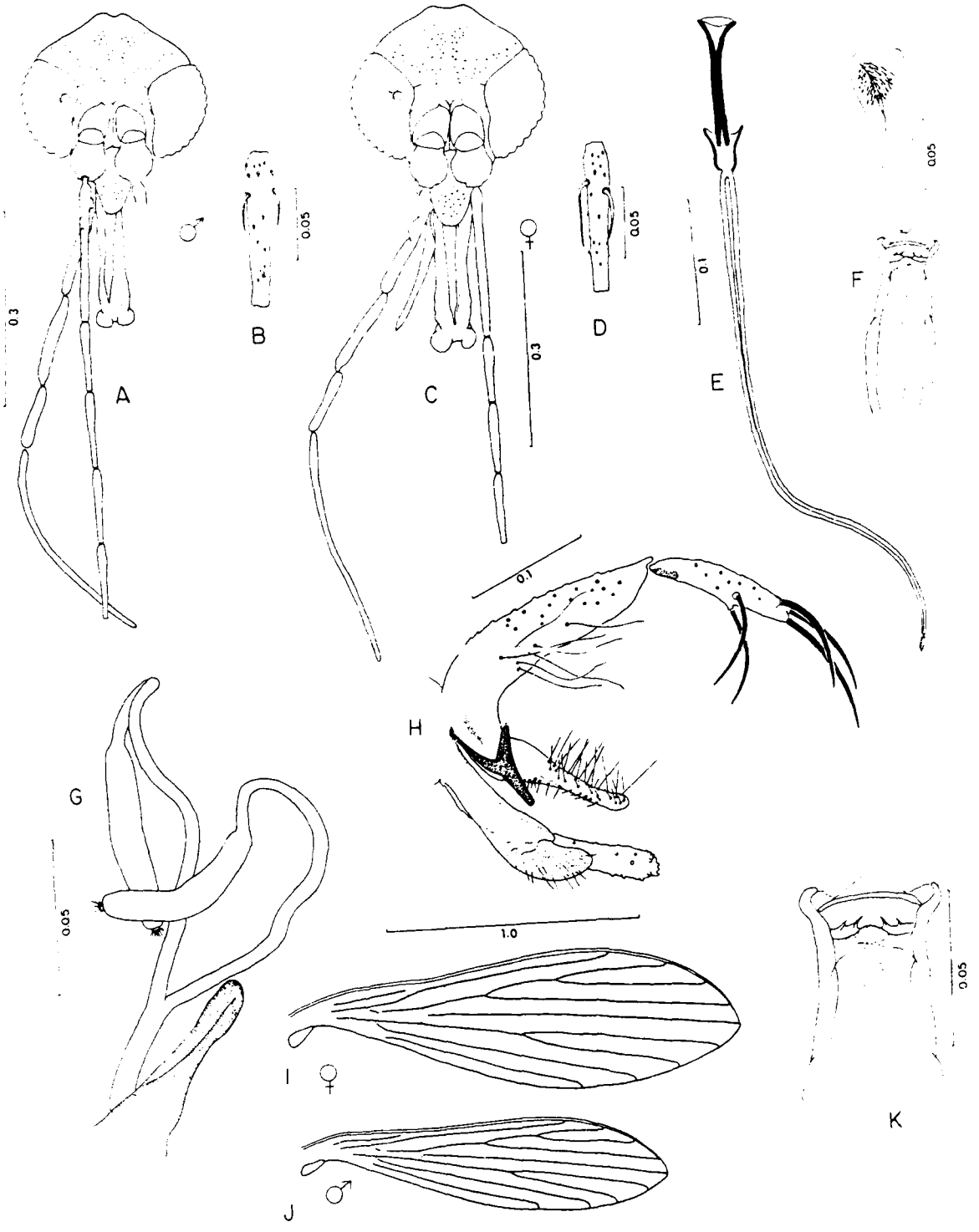



Plate 36-7

Lutzomyia trinidadensis. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Genital pump & filaments; F. Female cibarium & pharynx; G. Spermathecae; H. Male terminalia; I. Female wing; J. Male wing; K. Female cibarium (figs. from Young 1979).

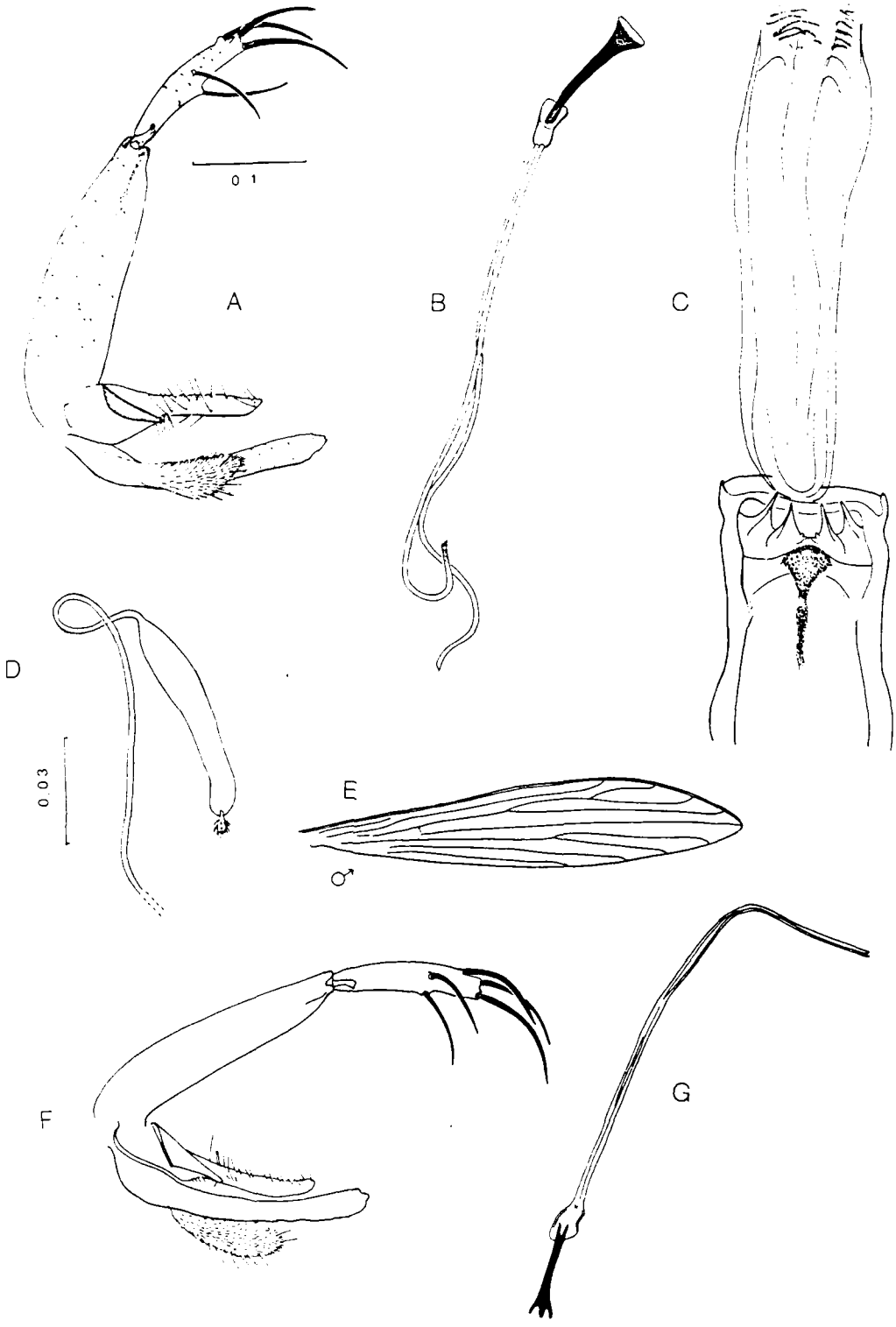



Plate 36-8

Lutzomyia goiana. A. Male terminalia; B. Genital pump & filaments; C. Female cibarium & pharynx; D. Spermatheca (fig. D after Martins et al. 1962c).

Lutzomyia machupicchu. E. Male wing; F. Male terminalia; G. Genital pump & filaments (figs. from Martins et al. 1975c).

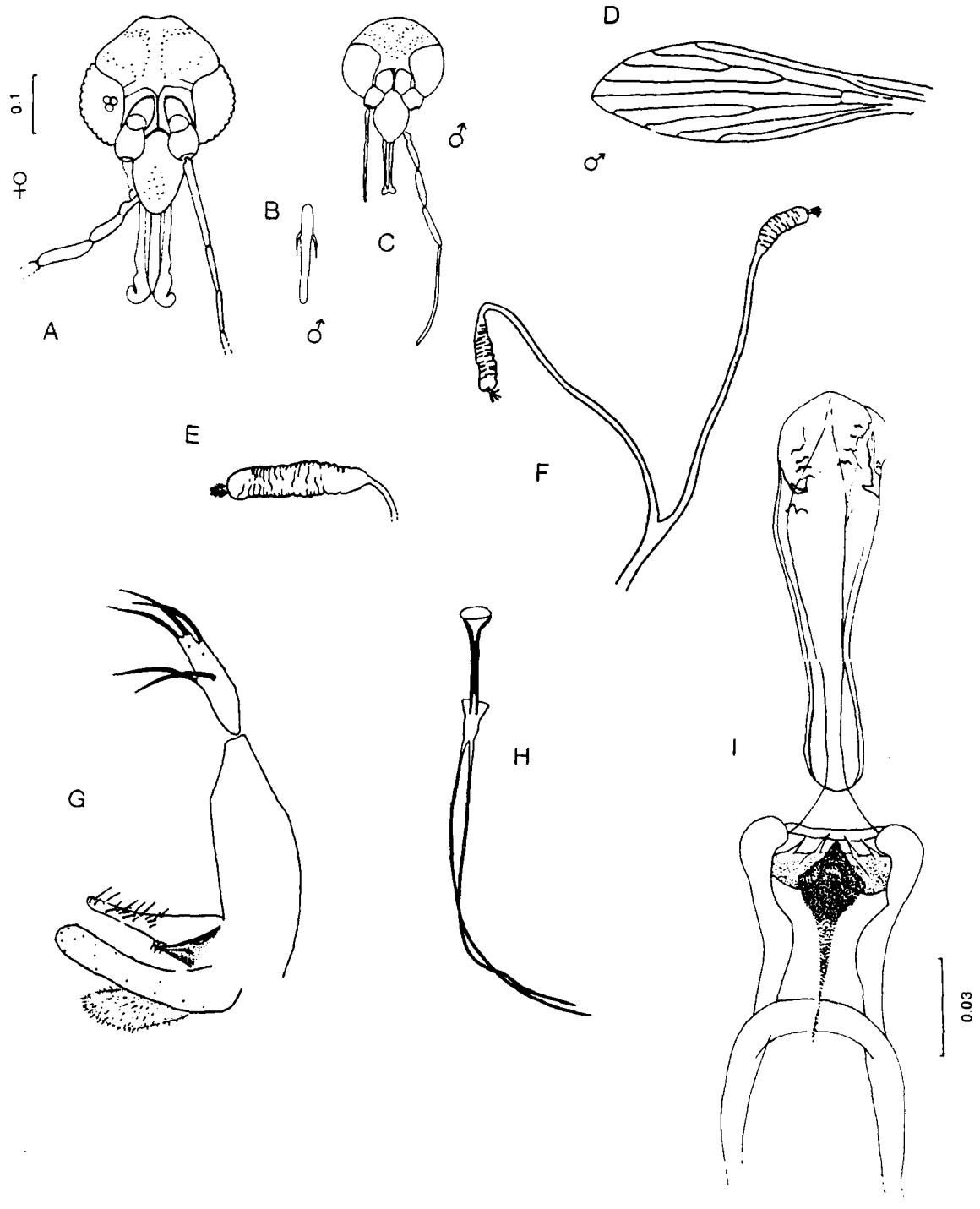



Plate 36-9

Lutzomyia peresi. A. Female head; B. Male flagellomere II; C. Male head; D. Male wing; E. Spermatheca; F. Spermathecae; G. Male terminalia; H. Genital pump & filaments; I. Female cibarium & pharynx (all figs. except F & I from Dias et al. 1986a).

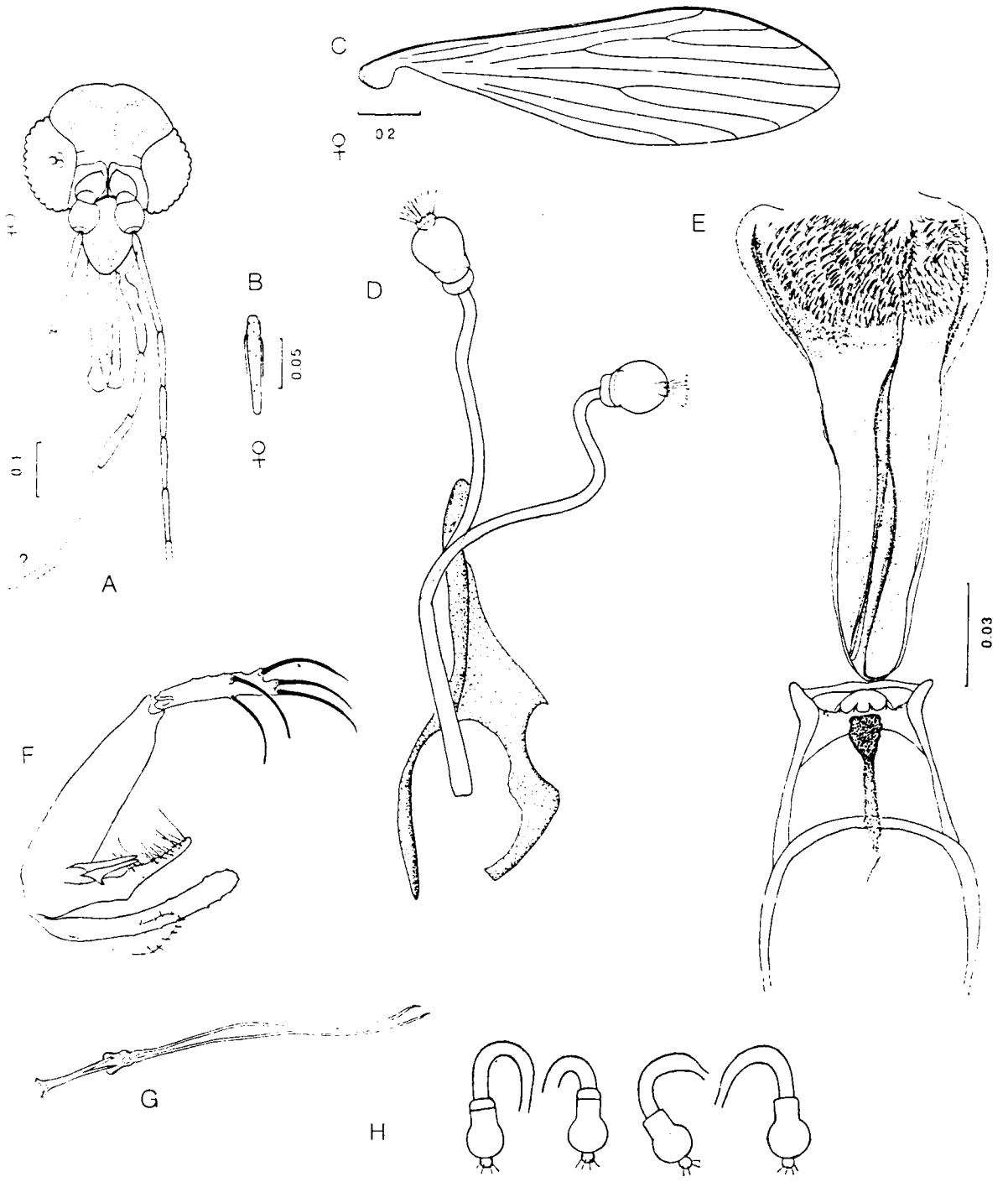



Plate 36-10

Lutzomyia capixaba. A. Female head; B. Female flagellomere II; C. Female wing; D. Spermathecae; E. Female cibarium & pharynx; F. Male terminalia; G. Genital pump & filaments (male figs. from Dias et al. 1987).

Lutzomyia fonsecai. H. Spermathecae (after Costa Lima 1932).

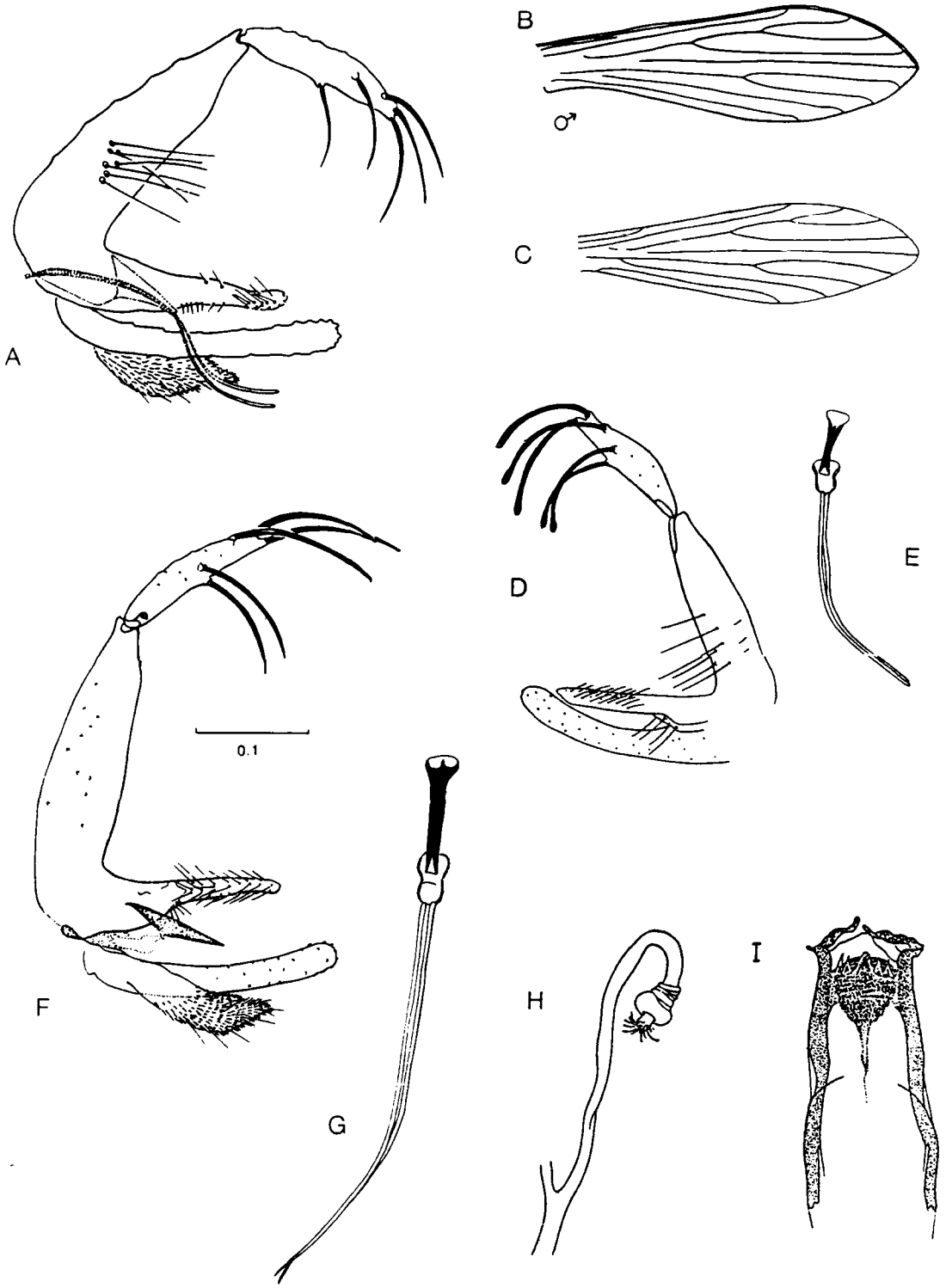



Plate 36-11

Lutzomyia ferreirana. A. Male terminalia; B. Male wing (figs. after Barretto et al. 1958).

Lutzomyia pratti. C. Male wing; D. Male terminalia; E. Genital pump & filaments (figs. after Vargas & Najera 1951a).

Lutzomyia oswaldoi. F. Male terminalia; G. Genital pump & filaments; H. Spermatheca; I. Female cibarium (figs. H & I after Mangabeira 1942e).

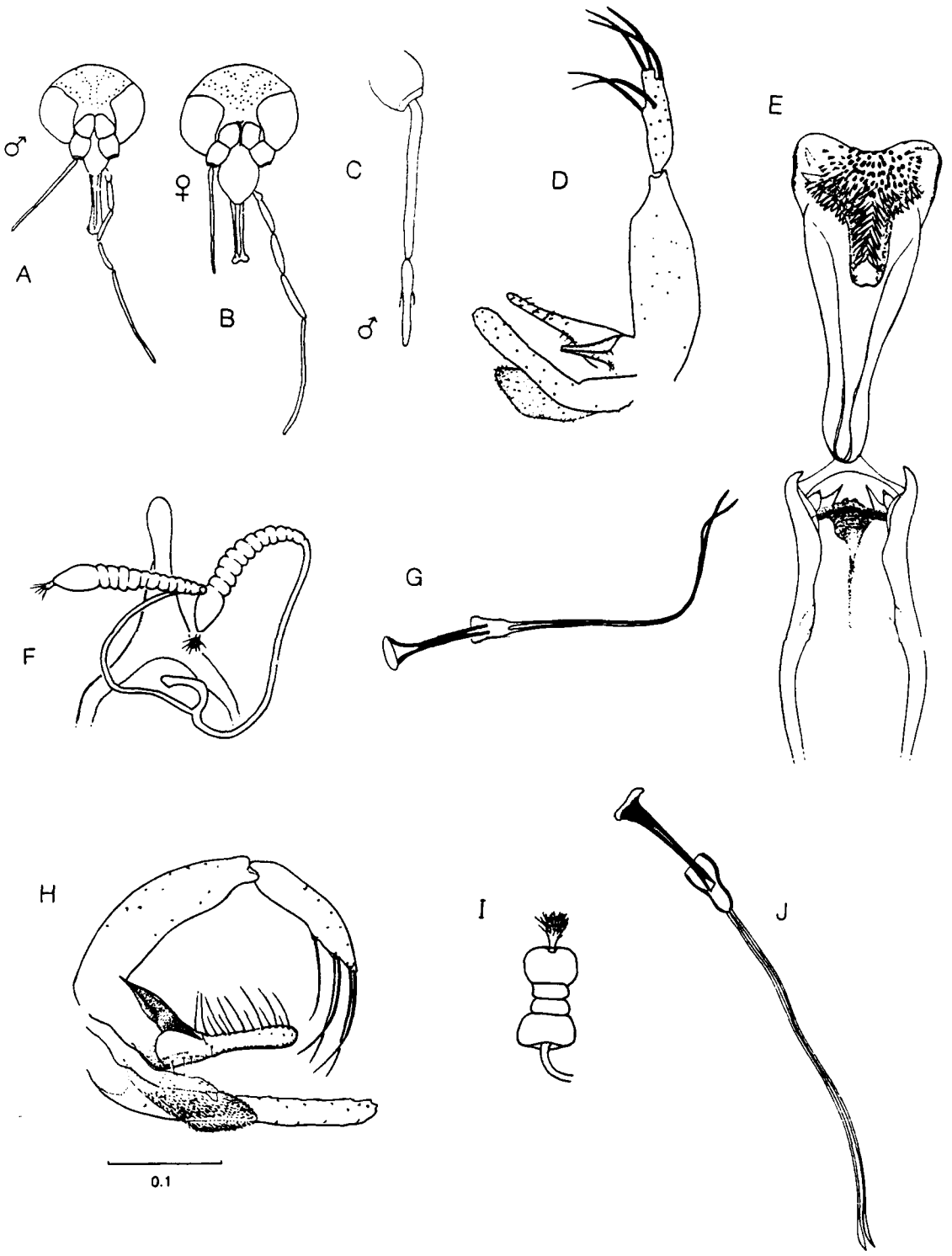
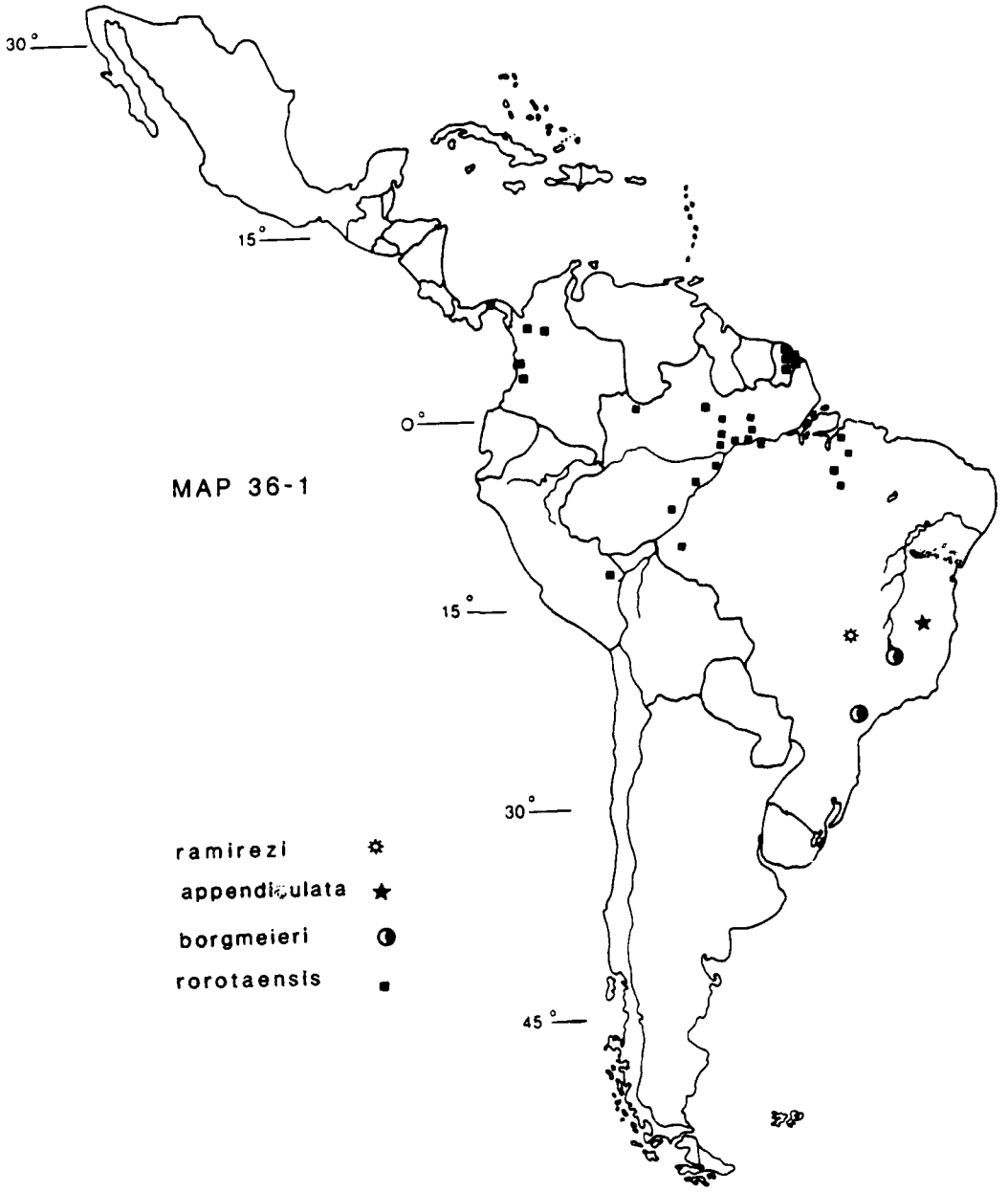



Plate 36-12

Lutzomyia pusilla. A. Male head; B. Female head; C. Male antenna, pedicel & basal flagellomeres; D. Male terminalia; E. Female cibarium & pharynx; F. Spermathecae; G. Genital pump & filaments (all figs., except E & F, after Dias et al. 1986b).

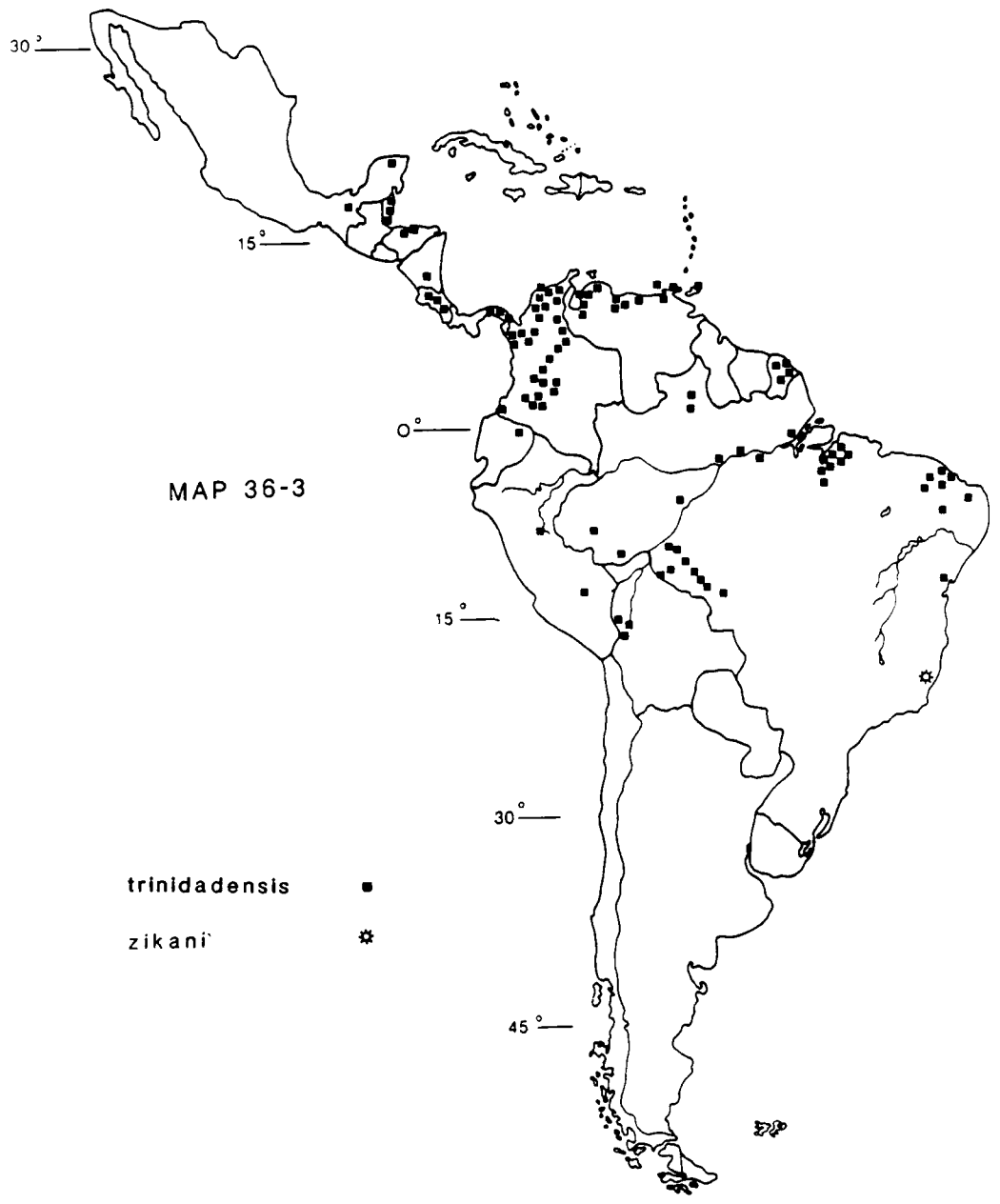
Lutzomyia alphabetica. H. Male terminalia; I. Spermathecae; J. Genital pump & filaments (fig. I after Barretto 1950a).


30°
15°
0°
15°
30°
45°
ramirezi
appendiculata
borgmeieri
rorotaensis

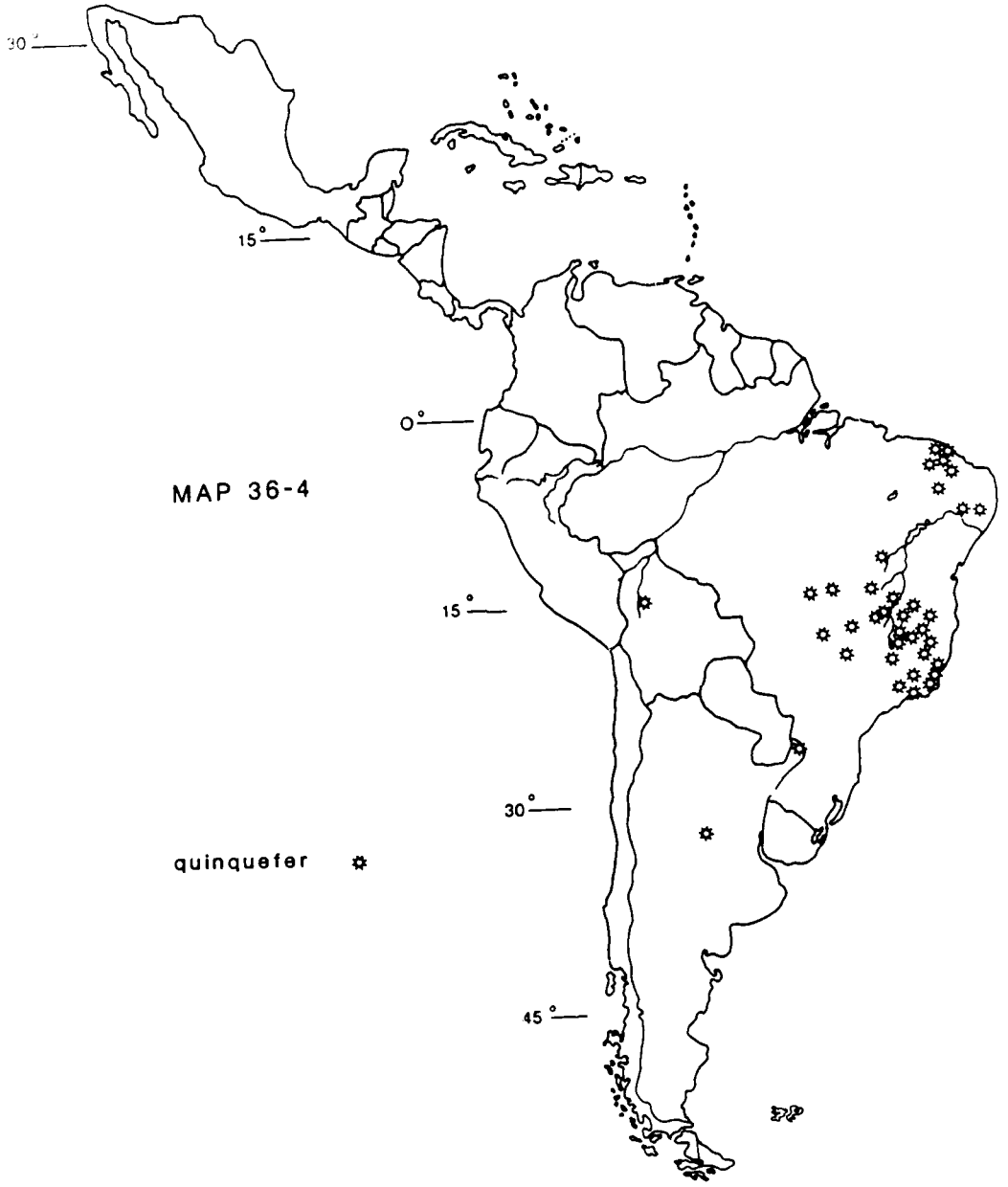
MAP 36-1




MAP 36-2




MAP 36-3




MAP 36-4

quinquefer ✡




MAP 36-5

oswaldoi ■

L. sp. No. 2 de Araracuara ✡

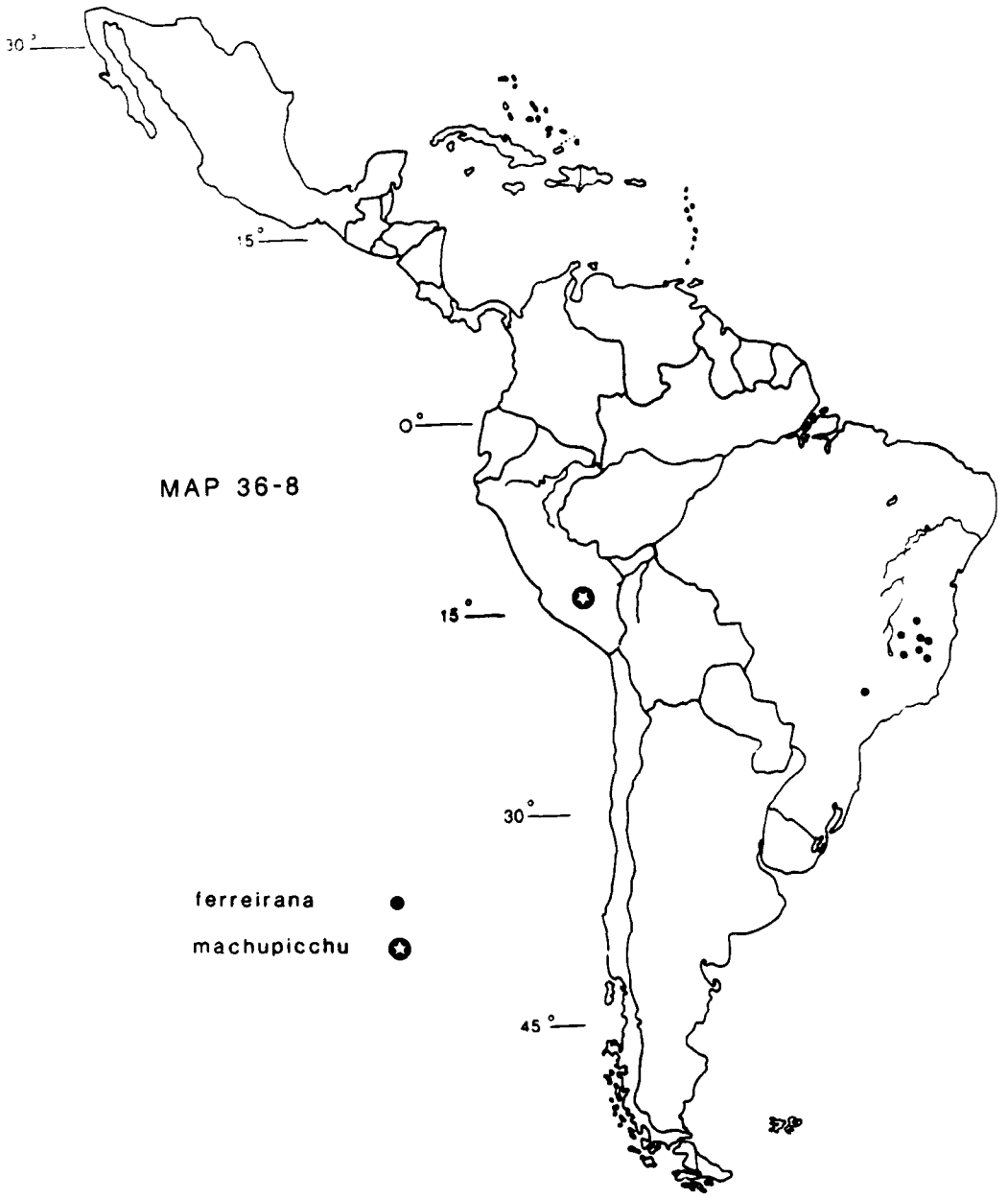



MAP 36-6

longipennis ✱




MAP 36-7




MAP 36-8




MAP 36-9




MAP 36-10

capixaba ■




MAP 36-11

pusilla ●

## 37. Lutzomyia Subgenus Helcocyrtomyia

Phlebotomus species group vexator Fairchild & Hertig 1961a: 325 (spp. keyed).

Lutzomyia subgenus Helcocyrtomyia Barretto 1962: 96 (type species: Phlebotomus peruensis Shannon by orig. designation).

Phlebotomus species group sanguinarius Ortiz 1965b: 25 (in part).

Lutzomyia species group vexatrix Theodor 1965: 183 (defined). Lewis et al. 1977: 325 (as species group vexator).

Lutzomyia subgenus Lutzomyia: Forattini 1971a: 99 (in part); 1973:

Psychodopygus subgenus Trichophoromyia: Forattini 1971a: 105 (in part); 1973:

Identification. Coloration pale to dark. Antennal ascoids simple. Palpomere 5 variable, shorter than or longer than palps. 3 + 4. ♀ cibarium with 4 nonslanted horizontal teeth; 1 or more rows of vertical teeth; incomplete or complete arch & distinct pigment patch. Spermathecae with or without incipient or complete annulations; individual sperm ducts longer than common duct. ♂ genitalia. Coxite with 1 or more persistent setae (exception L. tortura). Style with five large spines. Aedeagus longer than wide, subtriangular; filament tips simple, inflated or modified. Lateral lobes without modified setae.

Unlike Martins et al. (1978) and others, we exclude the oswaldoi group species from the subgenus Helcocyrtomyia. The males in these groups have 5 spines on their styles, the females have 4 horizontal teeth in their cibaria but in other aspects of structure and behavior, the taxa are distinct.

The Lutzomyia (Helcocyrtomyia) species in the vexator complex are reptile/amphibian feeders and occur in the northern Neotropics and in the Nearctic Region. The center of distribution of the species in the peruensis complex is in South America mostly in mountainous areas where some of the species are remarkably similar in structure.

Medical Importance. Many species in the peruensis complex are anthropophilic and two are suspected of transmitting Leishmania causing cutaneous leishmaniasis.

Key to the Males of the Subgenus Helcocyrtomyia*

1. Coxite with 6 or more setae forming a compact tuft or a loosely arranged basal median patch ..... 2

   Coxite with 0-5 setae at base of structure ..... 12

2. Style with 6 strong spines. Genital filaments >6.5X length of pump ..... L. vargasi (Pl. 37-1)

   Style with 5 strong spines. Genital filaments <6X length of pump ..... 3

*The males of L. botella and L. imperatrix have not been discovered.

3. Coxite with persistent setae loosely arranged, some extending into middle third of structure. Palpomere 5 shorter than, or subequal to palp. 3. Genital filaments ca. 5X length of pump ..... ..... L. cirrita (Pl. 37-2)
Coxite with setae forming a distinct tuft or group at inner base of structure. Palpomere 5 longer than, or subequal, to palp. 3. Genital filaments shorter than 5X genital pump length ..... 4

4. Style with isolated spine between terminal & proximal spines inserted at, or close to, middle of structure. Palpomere 5 longer than flagellomere I ..... L. noguchii (Pl. 37-3)
Style with isolated spine inserted at distal third of structure, often close to the terminal spines. Palpomere 5 shorter than flagellomere I ..... 5

5. Paramere with mostly spine-like setae on dorsum ..... 6
Paramere with thinner, longer setae on dorsum ..... 8

6. Style with basal spine isolated ..... ..... Lutzomyia (Helcocyrtomyia) n.sp. #1 (Pl. 37-4)
Style with paired basal spines, inserted more or less on same level ..... 7

7. Coxite tuft with longest setae reaching to distal 1/3 of coxite. ..... L. ayacuchensis (Pl. 37-5)
Coxite tuft with longest setae reaching only to middle 1/3 of coxite ..... L. peruensis (Pl. 37-6)

8. Labrum & lateral lobe subequal in length. Style with isolated subterminal spine much closer to terminal spines than to closest proximal spine ..... 9

Labrum shorter than lateral lobe. Style with isolated subterminal spine inserted almost equally between terminal spines & closest proximal spine ..... 10

9. Flagellomere I very long ( >0.65 mm), its end reaching beyond base of palpomere 5 ..... L. larensis (Pl. 37-8)*

Flagellomere I shorter ( <0.50 mm), its end reaching only to palpomere 4 ..... L. erwindonaldoi (Pl. 37-9)

10. Paramere relatively broad, its narrowest width nearly as wide as minimum width of lateral lobe ..... L. osornoi (Pl. 37-10)

Paramere more slender as shown ..... 11

11. Palpomere 3 subequal to, or slightly shorter, than twice length of palpomere 4. Paramere more slender in middle than at apex ... ..... L. strictivilla (Pl. 37-11)

Palpomere 3 clearly much shorter than twice length of palpomere 4. Paramere more slender at apex than in middle ..... L. pescei (Pl. 37-12)

---

*Lutzomyia ceferinoi (Pl. 37-7) will key to this couplet but no information is available on flagellomere length of this poorly known species. Arrendondo (1987) states that L. ceferinoi has fewer coxite setae (12-14) than L. larensis which has 20-24 such setae.

12. Wing venation with beta longer than half of alpha. Genital filaments markedly inflated at or near each tip (vexator complex)... 13

Wing venation with beta longer than half of alpha. Genital filaments not markedly inflated at or near each tip (peruensis complex in part) .....

13. Paramere as shown, its base with a dorsal spinose hump .....

..... L. vindicator (Pl. 37-14)

Paramere otherwise, without such a conspicuous hump ..... 14

14. Paramere with dorsal setae restricted to apical third of structure ..... L. oppidana (Pl. 37-15)

Paramere with dorsal setae covering at least apical half of structure ..... 15

15. Lateral lobe barely surpassing end of paramere. Style with paired basal spines ..... L. stewarti (Pl. 37-16)

Lateral lobe extending well beyond end of paramere. Style with isolated basal spine ..... L. vexator (Pl. 37-17)

16. Basitarsus of hind leg subequal in length to hind femur. Aedeagus & genital filament tips with blunt tips ..... L. sanguinaria (Pl. 37-18 & 37-19)

Basitarsus of hind leg clearly longer than hind femur. Aedeagus & genital filament tips pointed ..... 17

17. Coxite without persistent seta or setae ..... L. tortura (Pl. 37-21)

Coxite with 1-5 persistent setae at base ..... 18

18. Coxite with 2-3 setae at base, one markedly wider than others. Style with all spines on distal half of structure ..... ..... L. scorzai (Pl. 37-22)

Coxite with 3-5 setae at base, none markedly wider than others. Style with basal spine usually on proximal half of structure ..... 19

19. Coxite of 3 setae of equal length. Eyes separated by <4.5 facet diameters. Labrum or palpomere 5 longer than 0.30 mm ..... ..... Lutzomyia sp. of Pichinde (Pl. 37-22)

Coxite of 3-5 setae, one or more distinctly longer than others. Eyes separated by distance = to 5 or more facet diameters. Labrum or palpomere 5 shorter than 0.28 mm ..... L. hartmanni (Pl. 37-24)

## Key to the Females of the Subgenus Helcocyrtomyia*

1. Wing venation with beta longer than half of alpha (vexator complex) ..... 2

Wing venation with beta shorter than half of alpha (peruensis complex) ..... 5

2. Spermathecae as shown, with at least 4 distinctive annulations including large terminal annulation ..... L. stewarti (Pl. 37-16)

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*The females of L. ceferinoi and L. vargasi remain unknown.

Spermathecae otherwise, without annulations but transverse striations may be present on individual ducts near spermathecae .... 3

3. Individual sperm ducts shorter than 4X length of genital fork stem ..... 4

Individual sperm ducts longer than 5X length of genital fork stem ..... L. oppidana (Pl. 37-15)

4. Spermathecae and lower portion of individual sperm ducts wider than genital fork stem ..... L. vindicator (Pl. 37-14)

Spermathecae and lower portion of individual sperm ducts less than width of genital fork stem ..... L. vexator (Pl. 37-17)

5. Labrum subequal to, or shorter than, max. head width ..... 6

Labrum clearly longer than max. head width ..... 10

6. Spermathecae carrot shaped. Basitarsus of hind leg shorter than or = to length of hind femur ..... L. sanguinaria (Pl. 37-18 & 37-19)

Spermathecae otherwise. Basitarsus of hind leg longer than hind femur ..... 7

7. Palpomere 5 much longer than palpomere 3 ..... 8

Palpomere 5 subequal to, or shorter than, palpomere 3 ..... L. hartmanni (Pl. 37-24)

L. tortura (Pl. 37-21)

8. Labrum at least 10% shorter than flagellomere I ..... 9

Labrum & flagellomere I subequal in length ..... L. noguchii (Pl. 37-3)

9. Flagellomere I longer than 0.6 mm, subequal to or longer than, head height ..... L. larensis (Pl. 37-8)

Flagellomere I shorter than 0.4 mm, clearly shorter than head height ..... L. strictivilla (Pl. 37-11)

10. Flagellomere I longer than labrum ..... L. osornoi (Pl. 37-10)

Flagellomere I subequal to, or shorter than, labrum ..... 11

11. Spermathecae very large, sausage-shaped as shown ..... ..... L. botella (Pl. 37-20)

Spermathecae otherwise ..... 12

12. Eyes small, maximum height of eye shorter than, equal to, or but slightly greater than interocular distance ..... 13

Eyes larger, maximum height of eye greater than interocular distance ..... 14

13. Spermathecae with distinct hemispherical terminal annulation larger than others ..... L. peruensis (Pl. 37-6)

Spermathecae with terminal annulation smaller than others, collar-like ..... L. ayacuchensis (Pl. 37-5)

14. Labrum shorter than 0.45 mm ..... 15

Labrum longer than 0.45 mm ..... 16

15. Spermathecae as shown, longer but with shorter individual ducts ( 4X length of spermathecae). Scutum uniformly pigmented ..... ..... L. erwindonaldoi (Pl. 37-9)

Spermathecae shorter but with long individual ducts ( >7X length of spermathecae). Scutum with anterior pale band, contrasting with median-posterior parts ... Lutzomyia (Helcocyrtomyia) n.sp.#1 (Pl. 37-4)

16. Spermatheca as shown, its length ca. 2X maximum width ..... ..... L. pescei (Pl. 37-12)

? L. imperatrix (Pl. 37-13)

Spermatheca otherwise, its length at least 3X maximum width ..... 17

17. Genital fork stem markedly enlarged at apex. Spermathecae & ducts as shown. Palpomere 5 shorter than palp. 3 ..... L. cirrita (Pl. 37-2)

Genital fork stem not enlarged at apex. Spermathecae & ducts otherwise. Palpomere 5 longer than palp. 3 ..... L. scorzai (Pl. 37-22)

Lutzomyia sp. of Pichinde (Pl. 37-23)

## Lutzomyia (Helcocyrtomyia) vargasi (Fairchild & Hertig)

Plate 37-1

Phlebotomus vargasi Fairchild & Hertig 1961a: 24 (♂, Canon de Lobos, Morelos, Mexico).

Lutzomyia vargasi: Theodor 1965: 183. Forattini 1971: 103; 1973: 357 (♂, fig). Martins et al. 1978: 168).

Distribution (Map 37-1). Mexico (type locality).

Remarks. This species remains known from a single male, the holotype, that may be aberrant because of the 6-spined style.

## Lutzomyia (Helcocyrtomyia) cirrita Young & Porter

Plate 37-2

Lutzomyia cirrita Young & Porter 1974: 321 (♂, ♀, Rio Anori, Antioquia, Colombia). Martins et al. 1978: 78. Young 1979: 197 (dist., ♂, ♀ figs.). Porter & De Foliart 1981: 157 (listed).

Phlebotomus cirrita: Ortiz 1978: 206 (listed).

Distribution (Map 37-2). Colombia (Young 1979).

## Lutzomyia (Helcocyrtomyia) noguchii (Shannon)

Plate 37-3

Phlebotomus noguchii Shannon 1929, in Noguchi et al. 1929: 996 (♂, Rimac Valley, Lima, Peru). Shannon 1929: 84 (♂, ♀ figs.). Hertig 1938: 463 (♀ figs.); 1942: 23 (biol., relationship with Bartonella); 1943: 249 (tax.). Rozeboom 1947b: 181 (figs.). Fairchild & Hertig 1957: 330 (refs., keyed, tax.).

Flebotomus noguchii: Barretto 1947a: 214 (refs.).

Lutzomyia noguchii: Barretto 1962: 96 (listed). Forattini 1973: 261 (figs., tax.). Martins et al. 1978: 79 (dist.). Llanos 1981: 183 (listed, Peru). Young et al. 1985: 141 (♂, ♀ figs.). Vargas & Perez 1985: 5 (Ancash, Peru).

Distribution (Map 37-3). Peru (Martins et al. 1978; ♂♂, near Arequipa, 1987, E. Rogers).

Remarks. Hertig (1942) summarized his extensive work on the distribution and habits of L. noguchii, noting that "the chief or perhaps sole hosts of this sandfly are field-mice." Earlier, Shannon (1929) misidentified many specimens of L. noguchii (as L. verrucarum) and mistakenly believed that L. noguchii was the vector of Bartonella to man in the Peruvian Andes (Hertig 1942). This species was recently collected in a cave near Arequipa, Peru (E. Rogers, pers. comm.), a locality representing the southernmost locality from which it has been found.

## Lutzomyia (Helcocyrtomyia) n.sp. #1

Plate 37-4

Distribution (Map 37-6). Peru (♂♂, ♀♀, Ambo, Huanuco, April 1987, A. Tejada).

Remarks. The male of this new species differs from L. pescei in details of the terminalia, especially the broader coxite setae and the shape and setation of the parameres. The female of L. pescei has longer individual sperm ducts and labrum, among other distinguishing features.

Lutzomyia (Helcocyrtomyia) ayacuchensis Caceres & Galati

Plate 37-5

Lutzomyia ayacuchensis Caceres & Galati 1988: 55 (♂, ♀, Quebrada Saquihuacca, 2740 M above sea level, Parinacochas Prov., Ayacucho, Peru).

Distribution (Map 37-4). Peru (Caceres & Galati 1988).

Remarks. This species is closely allied to L. peruensis from which it differs in the female by the shape of the spermathecae. The male of L. ayacuchensis has longer setae of the coxite tuft, the longest of which extend to the level of the distal third of the coxite. Comparable setae of L. peruensis extend only to the middle third of the coxite. Other metrical differences are given by Caceres & Galati, cited above.

Lutzomyia (Helcocyrtomyia) peruensis (Shannon)

Plate 37-6

Phlebotomus peruensis Shannon 1929: 996 in Noguchi et al. 1929 (♂, ♀ Matucana, Lima, Peru). Shannon 1929: 85 (♂, ♀). Hertig 1942: 23 (biol., relationship with Bartonella); 1943: 249 (♀ fig.); 1948: 8. Fairchild & Hertig 1957: 330 (refs., figs., keyed).

Flebotomus peruensis Barretto 1947a: 217 (refs.).

Lutzomyia peruensis: Barretto 1962: 96. Theodor 1965: 183 (spermatheca fig.). Forattini 1973: 234 (figs., tax.). Llanos et al. 1975b: 671 (Peru). Martins et al. 1978: 79 (dist., refs.). Llanos 1981: 183 (listed, Peru). Young et al. 1985: 141 (♂, ♀ figs.).

Distribution (Map 37-5). Peru (Martins et al. 1978; Llanos 1981; ♂♂, ♀♀, near Otuzco, Trujillo, 1981, L. Cruzado).

Remarks. Lutzomyia peruensis, a large & anthropophilic sand fly, occurs in the Peruvian Andes at elevations ranging from 800 M to above 3200 M above sea level (Hertig 1942; E. Perez, pers. comm.). Unidentified Leishmania (Romero et al. 1987) were recovered from hamsters that had been inoculated with triturated L. peruensis captured in the Rimac Valley (Herrer 1982). It remains to be determined, however, whether this species is a vector of Leishmania to man in uta-endemic localities of Peru.

Caceres & Galati (Rev. Brasil. Ent. 1988, 32: 55-61) illustrated both sexes of L. peruensis and compared them with L. ayacuchensis.

## Lutzomyia (Helcocyrtomyia) ceferinoi (Ortiz & Alvarez)

Plate 37-7

Phlebotomus ceferinoi Ortiz & Alvarez 1963a: 285 (♂, Biscucuy, Portuguesa, Venezuela); 1963b: 314 (♂). Ortiz 1978: 207 (♂, redescript.).

Lutzomyia ceferinoi: Theodor 1965: 183 (listed). Forattini 1973: 351 (♂ fig.). Martins et al. 1978: 78. Feliciangeli 1980: 261 (keyed). Ramirez Perez et al. 1982b: 58 (♂ fig., Tachira, Venezuela).

Distribution (Map 37-2). Venezuela (Ortiz & Alvarez 1963a; Ramirez Perez et al. 1982b).

Remarks. The original description of L. cererinoi was based on a single partially damaged male. Ortiz & Alvarez (1963a,b) published this description in two articles, and, later (Ortiz 1978), redescribed the male while adding a photograph of the male terminalia.

The holotype of L. ceferinoi is lost (D. Feliciangeli, pers. comm.) and the previous descriptions are inadequate for characterization. We are not fully convinced that Ramirez Perez (1982b) were dealing with this species in Tachira State, Venezuela.

## Lutzomyia (Helcocyrtomyia) larensis Arredondo

Plate 37-8

Lutzomyia larensis Arredondo 1987: 395 (♂, ♀, Yacambú National Park, Larra, Venezuela).

Distribution (Map 37-4). Venezuela (type locality & 1 ♂, Trujillo State, 1972, no other data).

## Lutzomyia (Helcocyrtomyia) erwindonaldoi (Ortiz)

Plate 37-9

Phlebotomus erwindonaldoi (Ortiz 1978: 205 (♂, Caja Seca, Zulia, Venezuela).

Lutzomyia erwindonaldoi: Young et al. 1987: 588 (natural flagellate infection, Colombia). Young & Morales 1987: 655 (♂, ♀ figs., Colombia).

Distribution (Map 37-1). Venezuela (Ortiz 1978; 1 ♂, Bueniquea, Tachira, 1979, D. Feliciangeli); Colombia (Young & Morales 1987).

Remarks. Females of L. erwindonaldoi are anthropophilic and are relatively common in coffee plantations at Arboledas and Durania, Norte de Santander Dpto., Colombia. The sexes have been properly associated (Young & Morales 1987).

## Lutzomyia (Helcocyrtomyia) osornoi (Ristorcelli & Van Ty)

Plate 37-10

Phlebotomus osornoi Ristorcelli & Van Ty 1941: 260 (♂, Valle de Capuli, Narino, Colombia). Rozeboom 1947a: 177 (♂).

Phlebotomus montoyai Sherlock 1962: 328 (♂, Chirristis, Narino, Colombia). Young & Porter 1974: 324 (as synonym of osornoi, full refs.).

Lutzomyia osornoi: Barretto 1962: 96. Theodor 1965: 183. Martins et al. 1978: 79 (refs.). Young 1979: 201 (refs., ♂, ♀ figs.).

Lutzomyia montoyai: Forattini 1971: 103; 1973: 261 (as junior synonym of noguchii).

Distribution (Map 37-1). Colombia (type locality).

Remarks. Forattini's belief that L. osornoi and L. noguchii are conspecific is incorrect. There are numerous structural differences between the taxa as shown in Plates 37-10 & 37-3.

### Lutzomyia (Helcocyrtomyia) strictivilla Young

Plate 37-11

Lutzomyia strictivilla Young 1979: 206 (♂, ♀, Rio Anori, Antioquia, Colombia). Porter & De Foliart 1981: 158 (mention).

Distribution (Map 37-1). Colombia (type locality).

Remarks. Females of this species have been captured in human bait at the type locality (Young 1979).

## Lutzomyia (Helcocyrtomyia) pescei (Hertig)

Plate 37-12

Phlebotomus pescei Hertig 1943: 248 (♀, Pincos Valley, Apurimac, Peru). Fairchild & Hertig 1957: 332 (refs., ♂, tax.).

Lutzomyia pescei: Barretto 1962: 96. Theodor 1965: 183. Forattini 1971: 100; 1973: 237 (♂, ♀ figs.). Martins et al. 1978: 80 (refs., dist.). Llanos 1981: 183 (listed).

Distribution (Map 37-1). Peru (Martins et al. 1978; Llanos 1981).

Remarks. Plate 37-12 of L. pescei is based on specimens illustrated and discussed by Fairchild & Hertig (1957). The possibility remains that the sexes are not properly associated due to the fact that males have not been taken at the type locality.

Hertig (1943) observed that females are anthropophilic.

## Lutzomyia (Helcocyrtomyia) imperatrix (Alexander)

Plate 37-13

Phlebotomus imperatrix Alexander 1944: 316 (♀, Huacapistana, Tarma, Junin, Peru). Dampf 1947a: 305 (♀, redescript.). Fairchild & Hertig 1957: 330 (refs.).

Lutzomyia imperatrix (or imperator): Theodor 1965: 183. Forattini 1971a: 103 (listed); 1973: 354 (♀ fig.). Martins et al. 1978: 168 (as inadequately described). Llanos 1981: 183 (listed).

Distribution (Map 37-2). Peru (type locality).

Remarks. Lutzomyia imperatrix remains known only from the female holotype, now in the collection of the USNM. Dampf (1947a) carefully redescribed the specimen but did not figure the spermathecae which probably resemble those of L. pescei or other species in the peruensis complex. Associated males will have to be secured before this species can be recognized. The cibarium as shown by Dampf (1947a) is similar to that of L. sanguinaria (Pl. 37-18).

## Lutzomyia (Helcocyrtomyia) vindicator (Dampf)

Plate 37-14

Phlebotomus vindicator Dampf 1944: 248 (♀, Cuauthla, Morelos, Mexico); 1947c: 205 (♂). Fairchild & Hertig 1957: 334 (refs., keyed).

Lutzomyia vindicatrix: Barretto 1962: 96 (listed). Theodor 1965: 183. Forattini 1971: 100 (as vinaicatrix); 1973: 273 (♂, ♀ figs.).

Lutzomyia vindicator: Martins et al. 1978: 77 (dist.).

Distribution (Map 37-6). Mexico (Martins et al. 1978).

Lutzomyia (Helcocyrtomyia) oppidana (Dampf)

Plate 37-15

Phlebotomus oppidanus Dampf 1944: 247 (♀, San Jacinto, Federal District, Mexico). Fairchild & Hertig 1957: 330 (♂, Mexico).

Lutzomyia oppidana: Barretto 1962: 96. Martins et al. 1978: 77 (dist.). Young & Perkins 1984: 277 (refs., dist., figs.).

Distribution (Map 37-3). Mexico (Martins et al. 1978); U.S.A & Canada (Young & Perkins 1984).

Lutzomyia (Helcocyrtomyia) stewarti (Mangabeira & Galindo)

Plate 37-16

Phlebotomus stewarti Mangabeira & Galindo 1944: 185 (♂, ♀, Livermore, California, U.S.A.). Dampf 1944: (Sonora, Mexico). Fairchild & Hertig 1957: 326 (keyed, refs.). Chaniotis 1967: 221 (rearing data, biology, hosts). Chaniotis & Anderson 1968: 273 (pop. dynamics).

Lutzomyia stewarti: Barretto 1962: 96. Ayala 1973: 266 (parasite relationships). Young & Perkins 1984: 278 (refs., keyed, figs.).

Distribution (Map 37-5). Mexico (Dampf 1944); U.S.A. (Young & Perkins 1984).

Lutzomyia (Helcocyrtomyia) vexator (Coquillett)

Plate 37-17

Flebotomus vexator Coquillett 1907: 102 (♂, ♀, Plummer's Island, Maryland, U.S.A.). Barretto 1947a: 229 (full refs.).

Phlebotomus vexator occidentis Fairchild & Hertig 1957: 334 (♂, ♀, California, U.S.A.). Young & Perkins 1984: 280 (not recognized as subspecies).

Lutzomyia vexator (or vexatrix): Young & Perkins 1984: 278 (tax. review, dist.). Klein et al. 1987: 154 (as experimental vector of Plasmodium mexicanum). Endris et al. 1987b: 413 (egg structure). Klein et al. 1988: 261 (as experimental host of Schellackia).

Distribution (Map 37-6). Mexico; U.S.A.; Canada (Martins et al. 1978; Young & Perkins 1984).

Remarks. This species, like L. oppidana, L. stewarti and probably L. vindicator, feed on reptiles and amphibians. Full references related to the habits, biology and disease relationships of L. vexator are given by Young & Perkins (1984).

Lutzomyia (Helcocyrtomyia) sanguinaria (Fairchild & Hertig)

Plate 37-18 and 37-19

Phlebotomus sanguinarius Fairchild & Hertig 1957: 332 (♂, ♀, Almirante, Bocas de Toro, Panama).

Lutzomyia sanguinaria: Barretto 1962: 96 (listed). Martins et al. 1978: 167 (refs., dist.). Young 1979: 201 (figs., refs.). Christensen & Herrer 1980a: 188 (experimental host of Leishmania aristedesi); 1980b: 523 (feeding habits). Chaniotis et al. 1982: 3 (control, Panama). Zeledón & Murillo 1983: 280 (Nicaragua). Christensen et al. 1983: 466 (coll. data, Panama). Murillo & Zeledón 1985: 99 (figs., Costa Rica).

Psychodopygus sanguinarius: Forattini 1971a: 105; 1973: 123 (figs., tax.).

Distribution (Map 37-5). Honduras (Fairchild & Hertig 1957); Nicaragua (Zeledón & Murillo 1983); Costa Rica (Murillo & Zeledón 1985); Panama (Fairchild & Hertig 1957; Martins et al. 1978); Colombia (Young 1979).

Remarks. The spermathecae of L. sanguinaria varies in length according to locality (Pl. 37-18 & 37-19). Females from Costa Rica (Murillo & Zeledón 1985, fig. 42) have very long spermathecae similar to those examined by us from La Fortuna, Chiriqui Prov., Panama. Two males from the latter site have modified tips of the genital filaments (Pl. 37-19) unlike those from other localities. The significance of this observation is not yet known and, thus, we hesitate to name these forms as distinct taxa.

Trypanosomes have been isolated from wild-caught L. sanguinaria in Panama (McConnell 1963).

## Lutzomyia (Helcocyrtomyia) botella

Plate 37-20

Phlebotomus botellus Fairchild & Hertig 1961b: 250 (♀, El Volcan, Chiriqui, Panama).

Lutzomyia botella: Theodor 1965: 186. Martins & Morales-Farias 1972b: 365. Martins et al. 1978: 161. Christensen et al. 1983: 466 (listed).

Psychodopygus botellus: Forattini 1971: 105; 1973: 459 (figs., tax.).

Distribution (Map 37-4). Panama (Fairchild & Hertig 1961b).

Remarks. Lutzomyia botella, a little known species occurring at relatively high elevations in western Panama, remains known only from the female. Apart from the inflated spermathecae that, nevertheless, resemble those of L. sanguinaria if expanded, the character states of wing venation, cibarium, palpi, ascoids of L. botella suggest the placement of this species in Helcyrtomyia.

Lutzomyia (Helcocyrtomyia) tortura Young & Rogers

Plate 37-21

Lutzomyia tortura Young & Rogers 1984: 605 (♂, ♀, Limoncocha, Napo, Ecuador). Young & Morales 1987: 662 (Amazonas, Colombia).

Distribution (Map 37-4). Ecuador (type locality); Colombia (Young & Morales 1987).

Remarks. The male of L. tortura is the only one known, so far, that lacks persistent setae on the coxite. In other aspects, both sexes resemble L. hartmanni. Females of L. tortura are anthropophilic. The species is likely more widespread in the western Amazon basin than present records indicate.

Lutzomyia (Helcocyrtomyia) scorzai (Ortiz)

Plate 37-22

Phlebotomus scorzai Ortiz 1965b: 28 (♂, ♀, Rancho Grande, Aragua, Venezuela).

Lutzomyia scorzai: Forattini 1971a: 100 (listed); 1973: 213 (figs., tax.). Martins et al. 1978: 81 (listed). Ramirez Perez et al. 1978: 52 (Aragua, Venezuela). Young 1979: 204 (♂, ♀ figs., Colombia). Feliciangeli 1980: 246 (keyed, figs.). Ramirez Perez 1982b: 58 (figs., Tachira, Venezuela).

Distribution (Map 37-5). Venezuela (Ramirez Perez et al. 1978; 1982b); Colombia (Young 1979).

Lutzomyia (Helcocyrtomyia) sp. of Pichinde Young

Plate 37-23

Lutzomyia sp. of Pichinde Young 1979: 210 (♂, ♀, figs., tax., Colombia).

Distribution (Map 37-6). Colombia (Young 1979).

Remarks. We are reluctant to provide a formal name for this species until, at least, we can study type material or topotype series of closely related species such as L. scorzai.

Lutzomyia (Helcocyrtomyia) hartmanni (Fairchild & Hertig)

Plate 37-24

Phlebotomus hartmanni Fairchild & Hertig 1957: 328 (♂, ♀, Cerro Campana, Panama).

Lutzomyia hartmanni: Barretto 1962: 96 (listed). Martins et al. 1978: 79 (refs., dist.). Young 1979: 199 (refs., figs.). Porter & De Foliart 1981: 85 (ecology, biting habits, Colombia). Morales et al. 1981: 201 (Tolima, Colombia). Christensen et al. 1983: 466 (coll. data, Panama). Young & Rogers 1984: 599 (Ecuador, cf. to tortura). Murillo & Zeledón 1985: 99 (♂, ♀ figs., Costa Rica). Hashiguchi et al. 1985a: 440

(natural Leishmania infections, Ecuador); 1985b: 533 (man biting activity, Ecuador).

Psychodopygus hartmanni: Forattini 1971a: 105; 1973: 466 (♂, ♀ figs., tax.).

Distribution (Map 37-3). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Morales et al. 1981); Ecuador (Young 1979; Hashiguchi et al. 1985a).

Remarks. This species is a suspected vector of Leishmania causing cutaneous leishmaniasis in Ecuador, but the specific identification of Leishmania found in naturally infected females from these is not yet known. In Santander Depto., Colombia, peripylarian promastigote infections were seen in two wild-caught females of L. hartmanni in 1987 (Young et al., unpubl. data). The parasites were cultured and attempts are now being made to identify the organisms.




Plate 37-1

Lutzomyia vargasi. A. Male head; B. Male flagellomere II; C. Genital pump & filaments; D. Male terminalia.

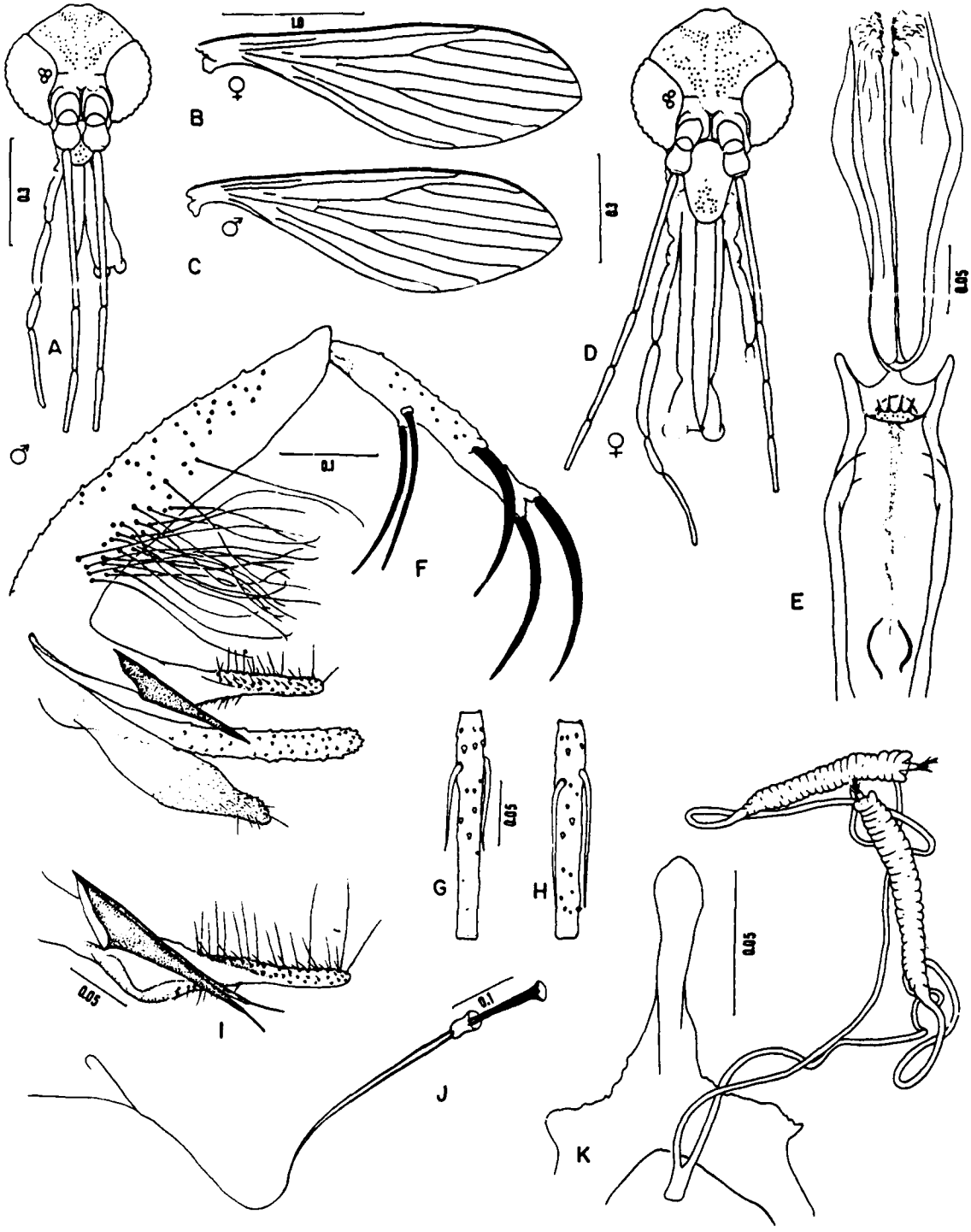



Plate 37-2

Lutzomyia cirrita. A. Male head; B. Female wing; C. Male wing; D. Female head; E. Female cibarium & pharynx; F. Male genitalia; G. Male flagellomere II; H. Female flagellomere II; I. Aedeagus & paramere; J. Genital pump & filaments; K. Spermathecae (All figures from Young and Porter, 1974)

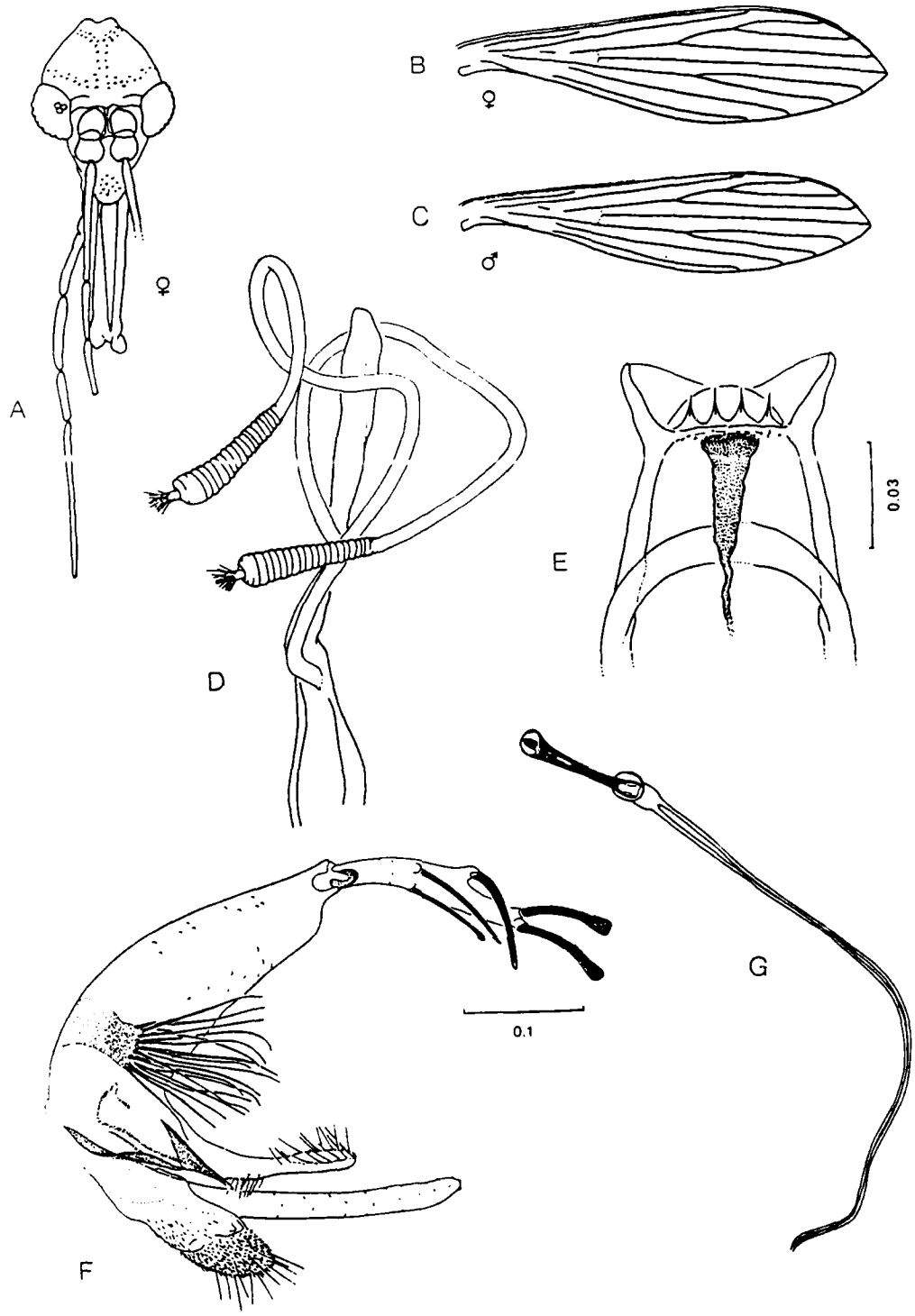



Plate 37-3

Lutzomyia noguchii. A. Female head; B. Female wing; C. Male wing; D. Spermathecae; E. Female cibarium; F. Male terminalia; G. Genital pump & filaments.

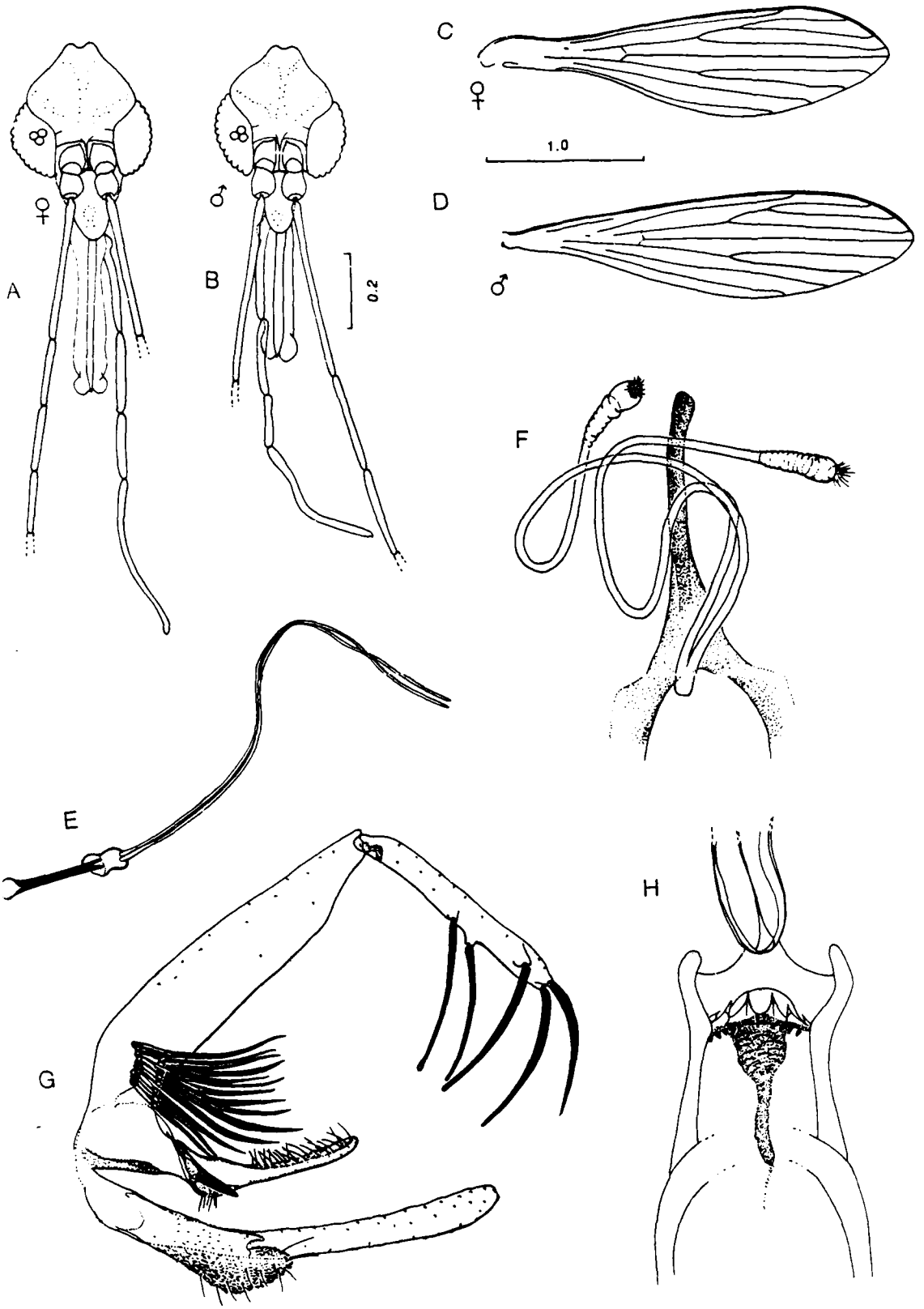



Plate 37-4

Lutzomyia (Helcocyrtomyia) n.sp. #1. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Genital pump & filaments; F. Spermathecae; G. Male terminalia; H. Female cibarium.

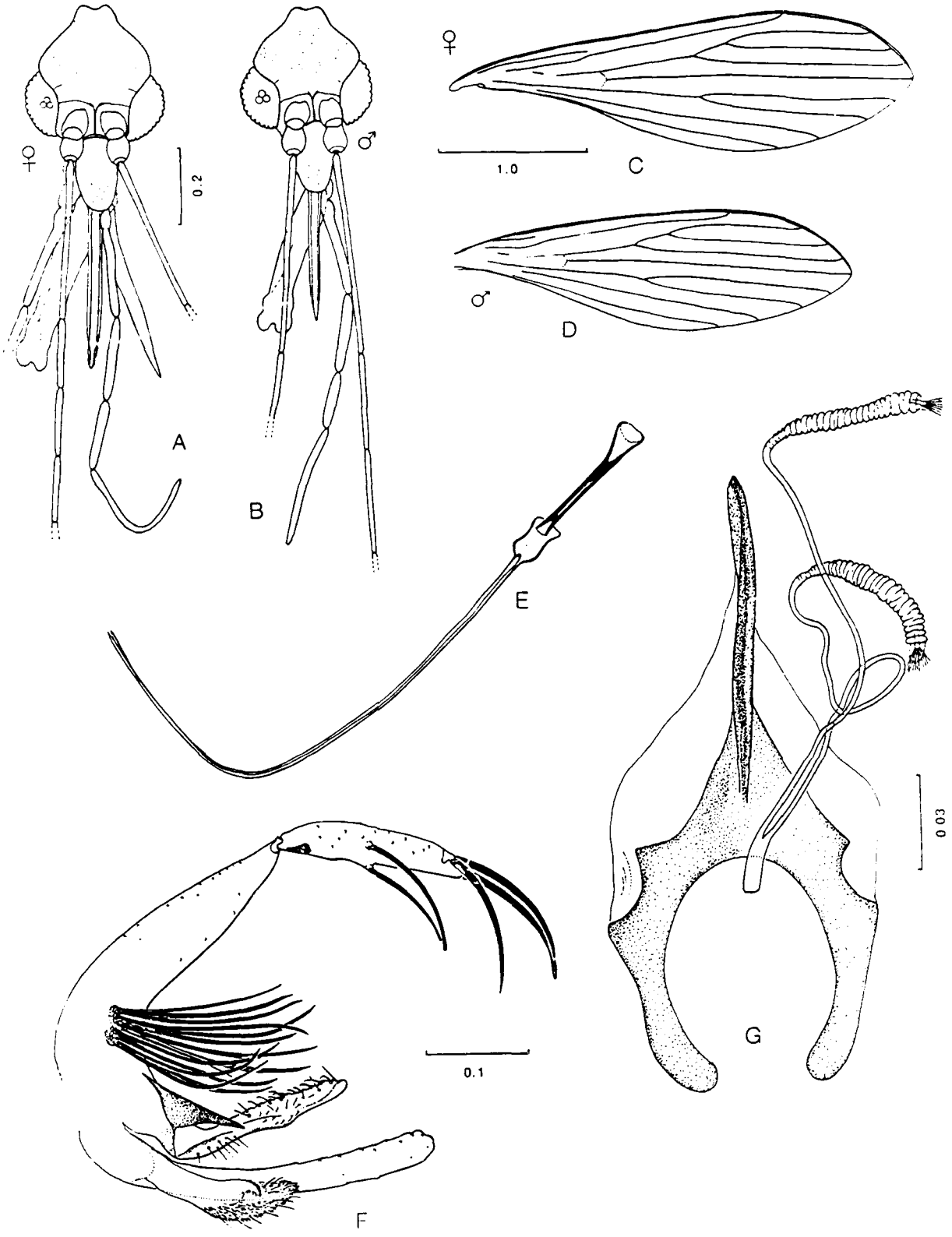



Plate 37-5

Lutzomyia ayacuchensis. A. Female head; B. Male head; C. Female wing; D. Male wing; E. Genital pump & filaments; F. Male terminalia; G. Spermathecae.

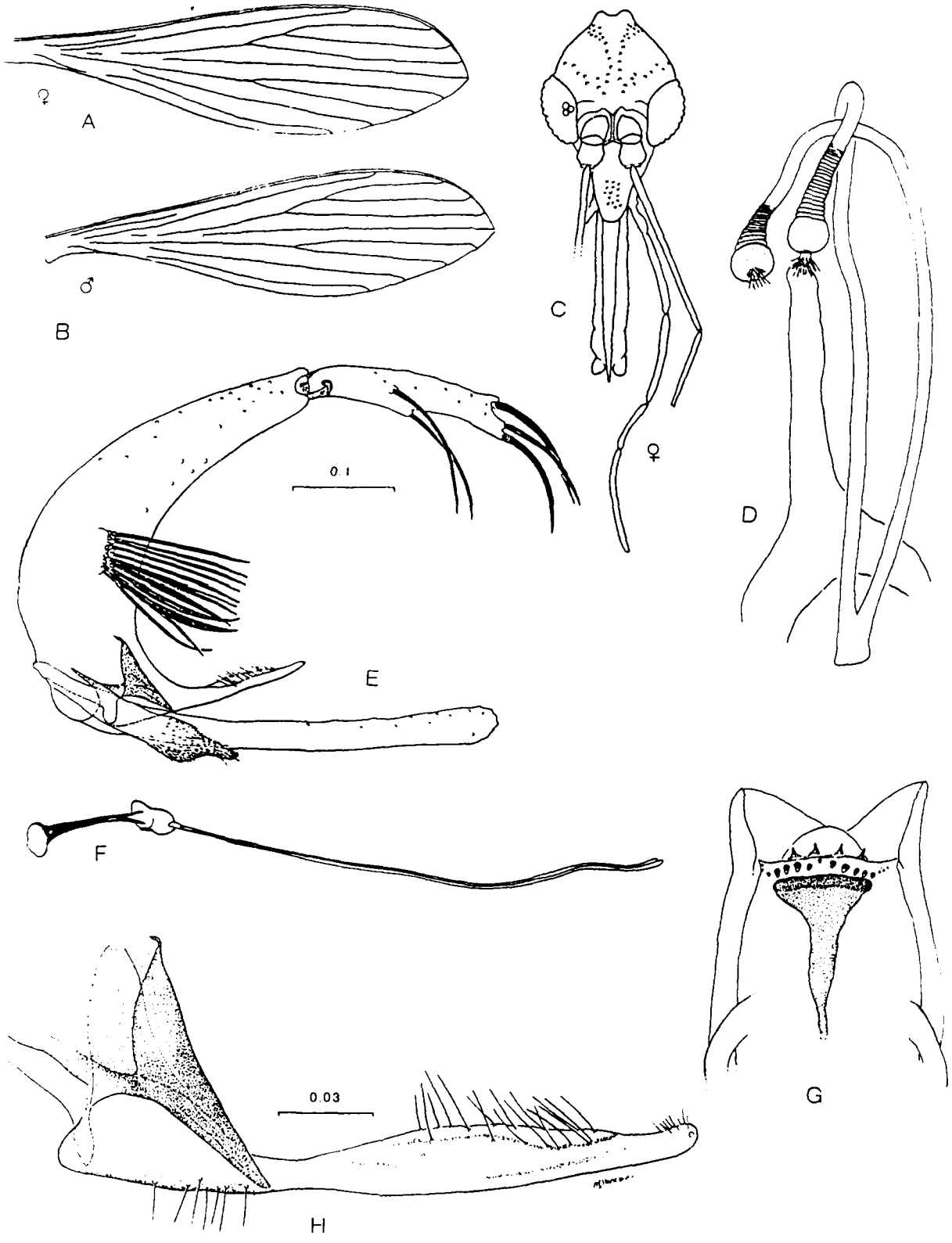



Plate 37-6

Lutzomyia peruensis. A. Female wing, B. Male wing, C. Female head, D. Spermathecae, E. Male terminalia, F. Genital pump & filaments, G. Female cibarium, H. Paramere & aedeagus.

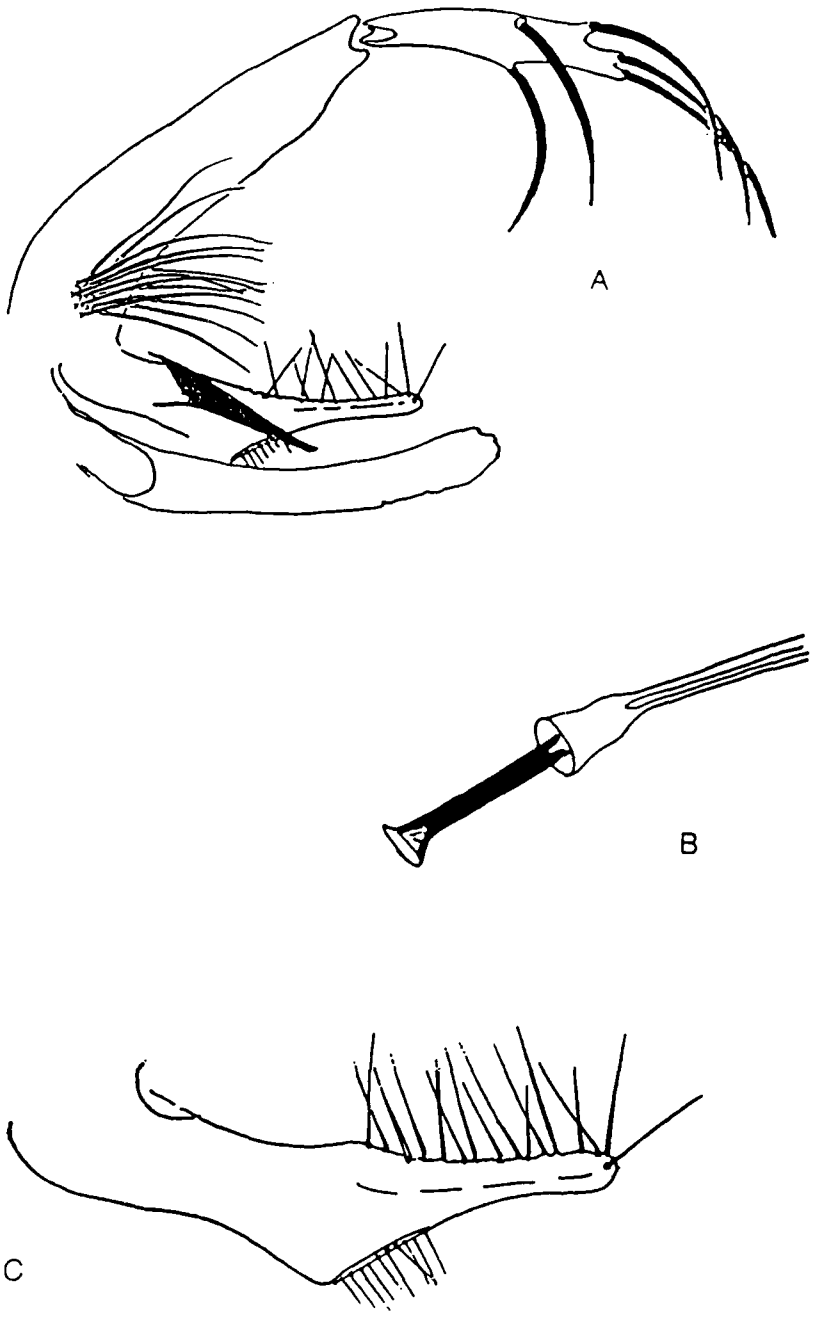



Plate 37-7

Lutzomyia ceferinoi. A. Male terminalia; B. Genital pump; C. Paramere (figs. from Ortiz & Alvarez 1963b).

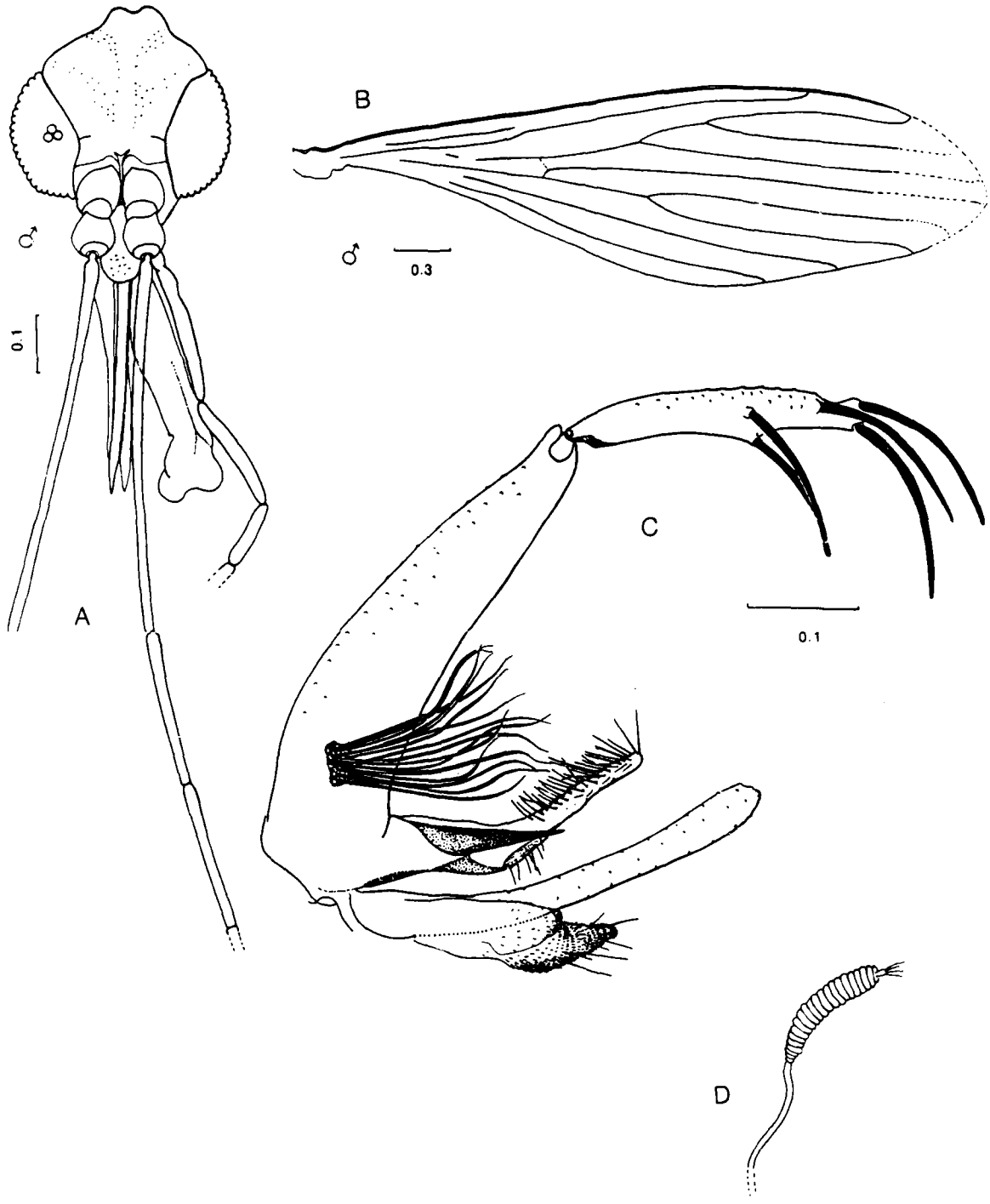



Plate 37-8

Lutzomyia larensis. A. Male head; B. Male wing; C. Male terminalia; D. Spermatheca (fig. D from Arrendondo 1987).

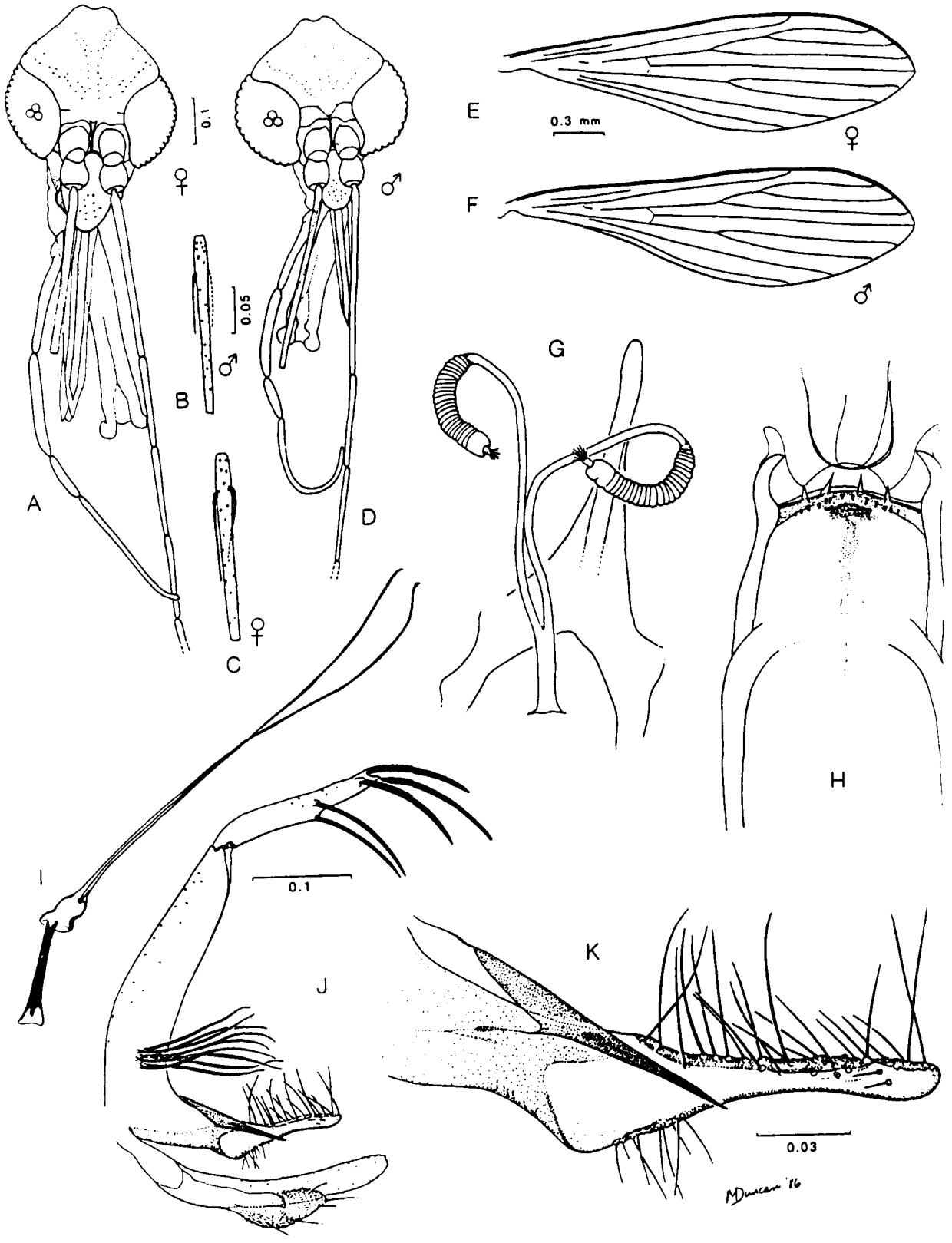



Plate 37-9

Lutzomyia erwindonaldoi. A. Female head; B. Male flagellomere II; C. Female flagellomere II; D. Male head; E. Female wing; F. Male wing; G. Spermathecae; H. Female cibarium; I. Genital pump & filaments; J. Male terminalia; K. Paramere (figs. from Young & Morales 1987).

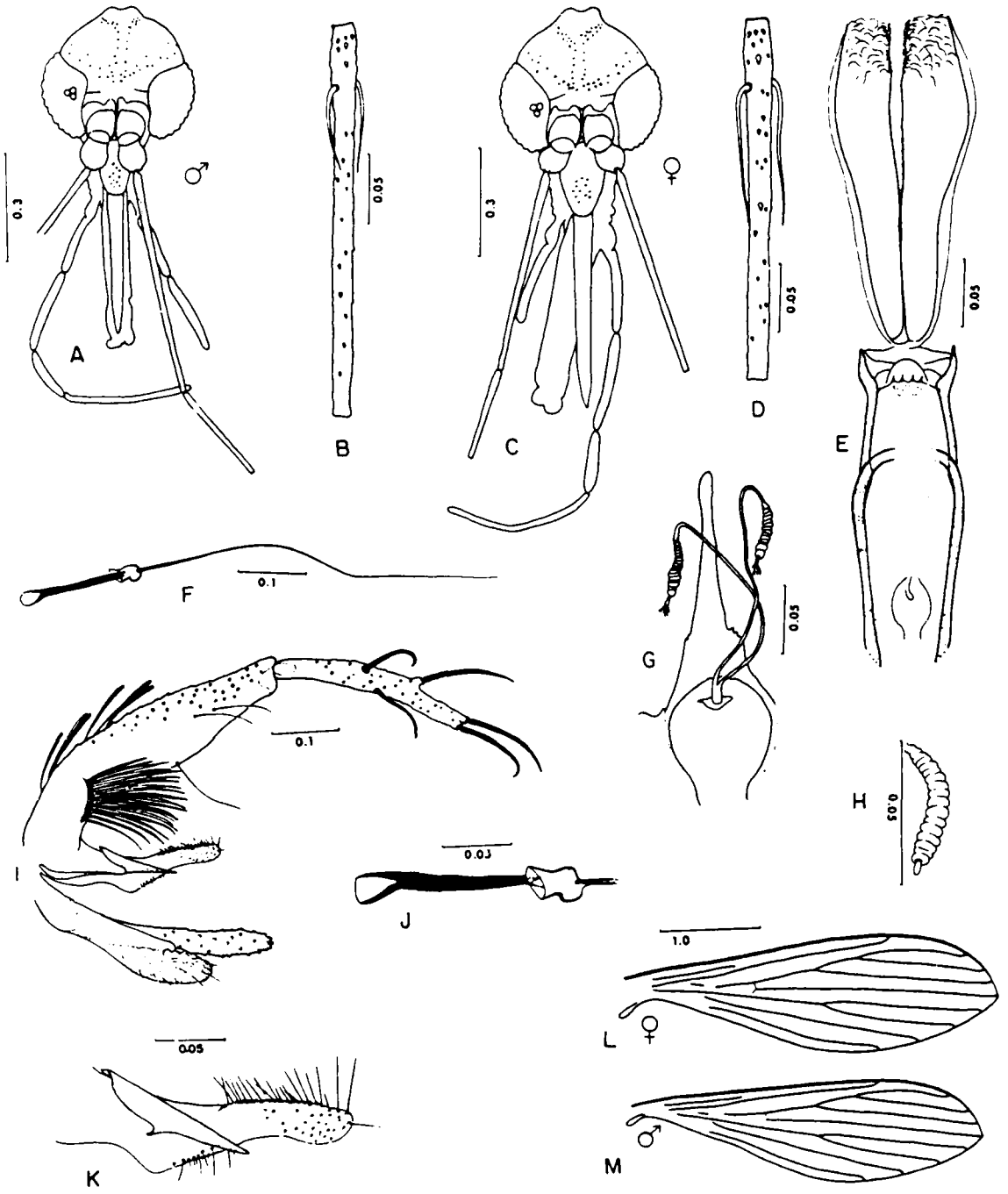



Plate 37-10

Lutzomyia osornoi. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Spermathecae; H. Body of spermathecae; I. Male genitalia; J. Genital pump; K. Aedeagus & paramere; L. Female wing; M. Male wing (from Young 1979).

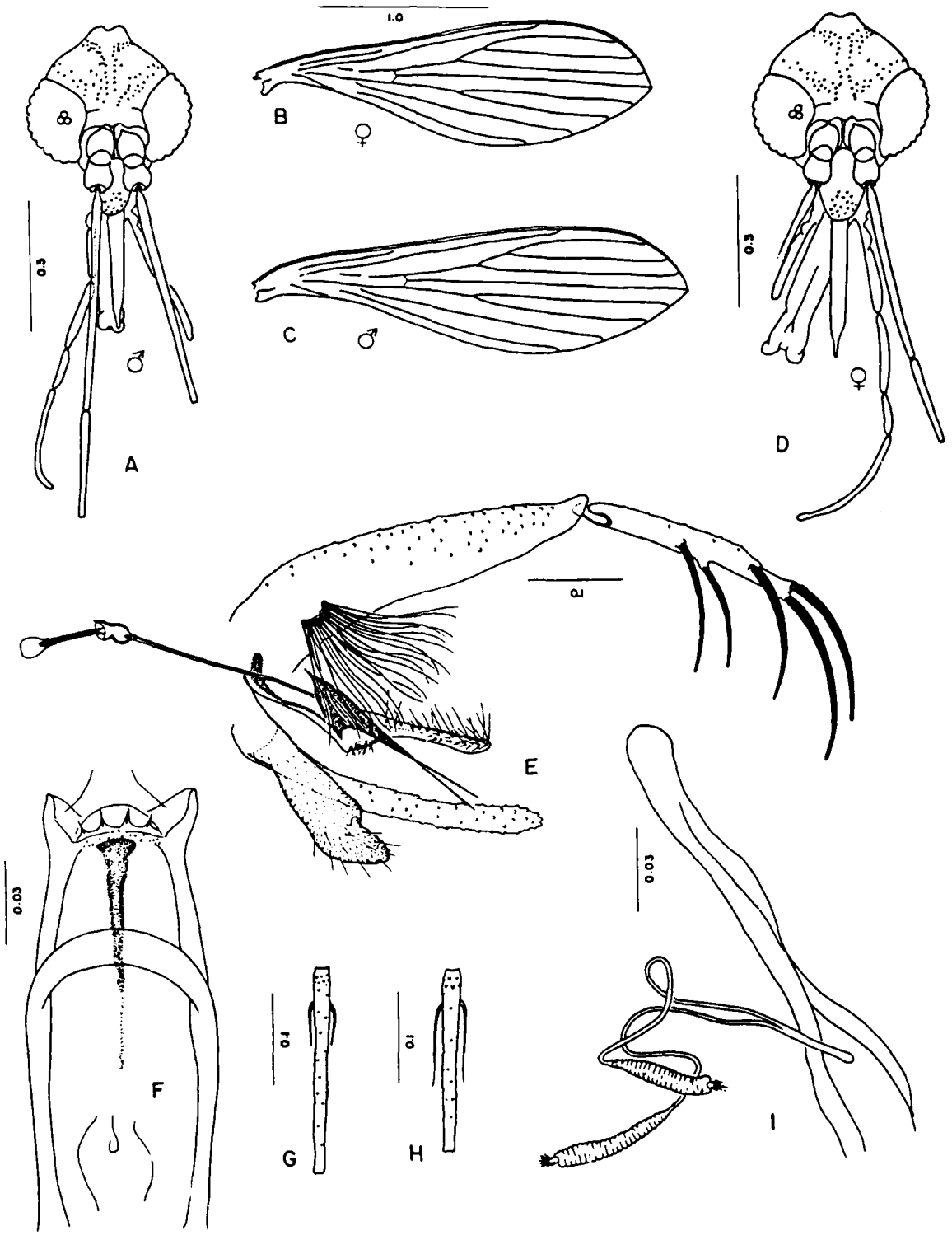



Plate 37-11

Lutzomyia strictivilla. A. Male head; B. Female wing; C. Male wing; D. Female head; E. Male genitalia; F. Female cibarium; G. Male flagellomere II; H. Female flagellomere II; I Spermathecae (from Young 1979).

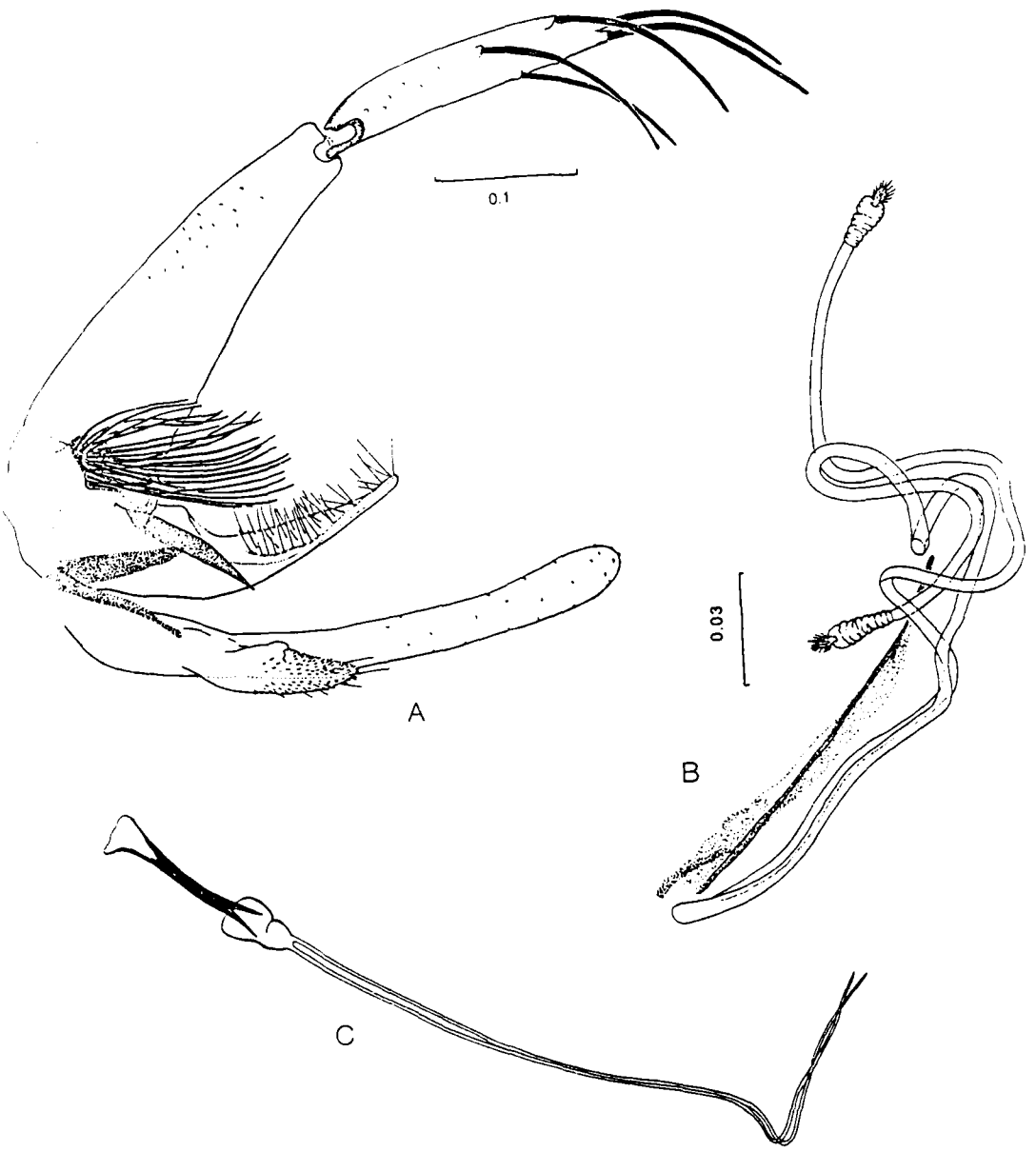



Plate 37-12

Lutzomyia pescei. A. Male terminalia; B. Spermathecae; C. Genital pump & filaments.

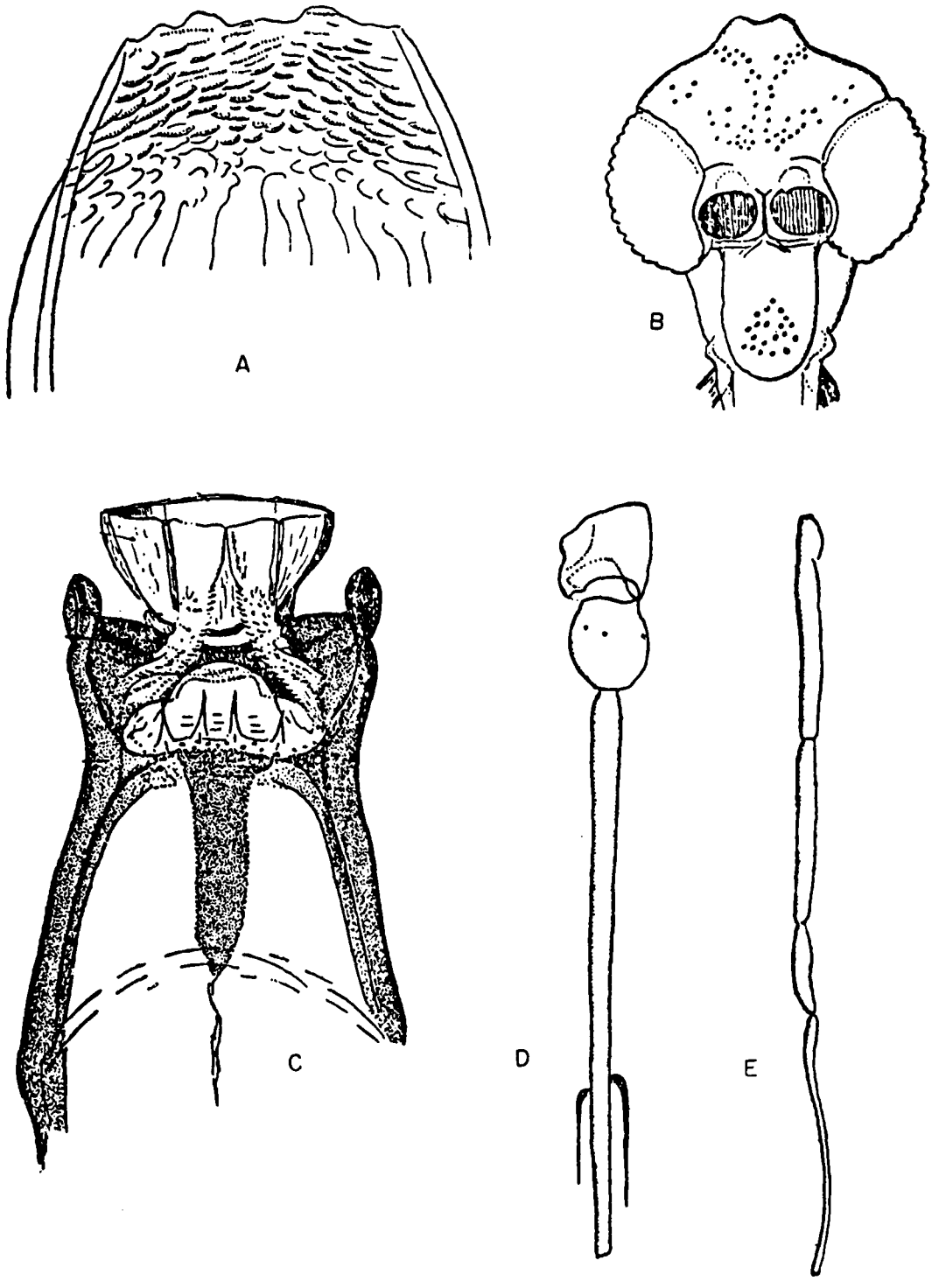



Plate 37-13

Lutzomyia imperatrix. A. Posterior end of pharynx; B. Female head; C. Female cibarium; D. Proximal flagellomere showing ascoids & scape & pedicel; E. Female palpus (all figs. from Dampf 1947a).

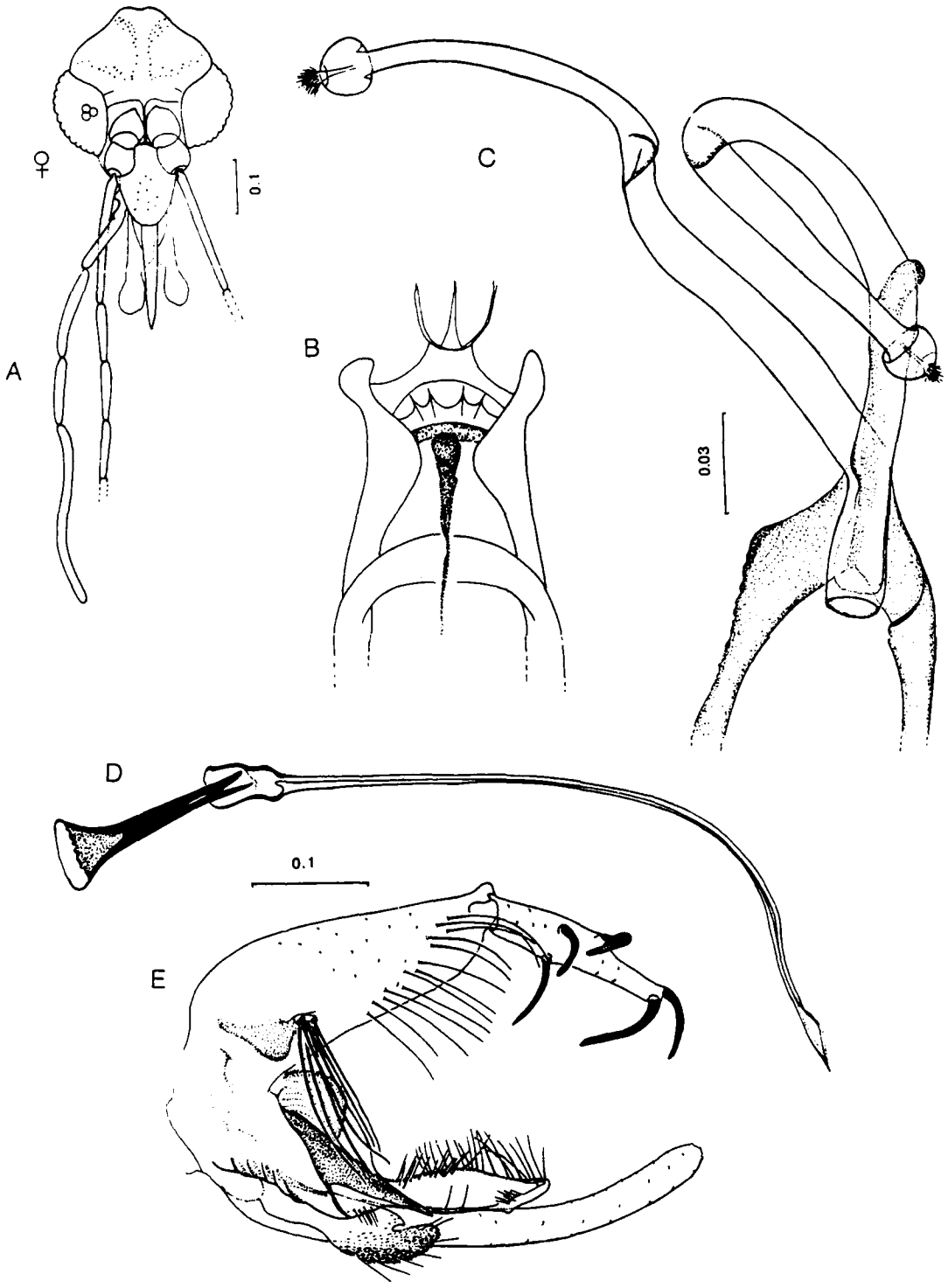



Plate 37-14

Lutzomyia vindicator. A. Female head; B. Female cibarium; C. Spermathecae; D. Genital pump & filaments; E. Male terminalia.

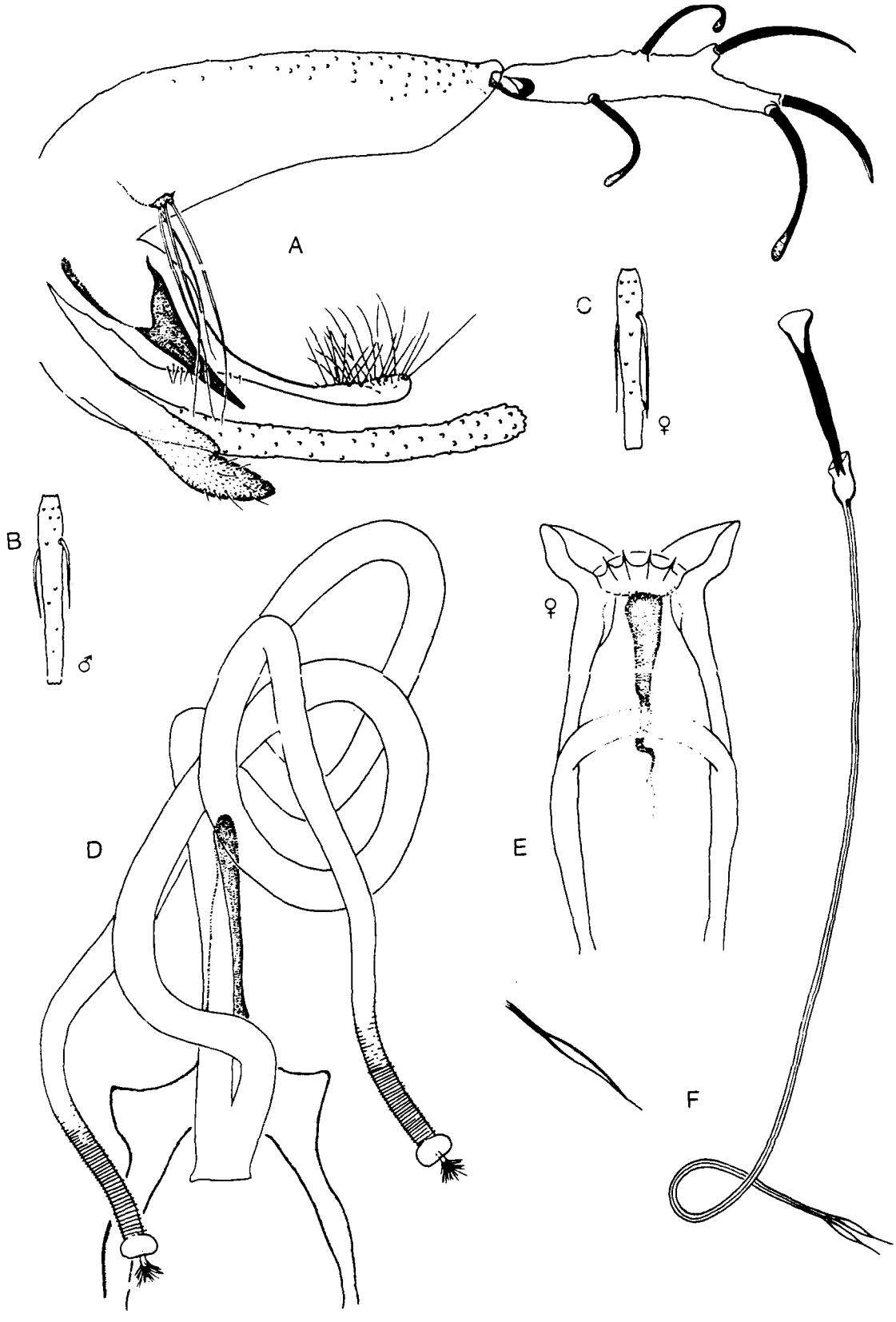



Plate 37-15

Lutzomyia oppidana. A. Male terminalia; B. Male flagellomere II; C. Female flagellomere II; D. Spermathecae; E. Female cibarium; F. Genital pump & filaments, tip of one filament enlarged (from Young & Perkins 1984).

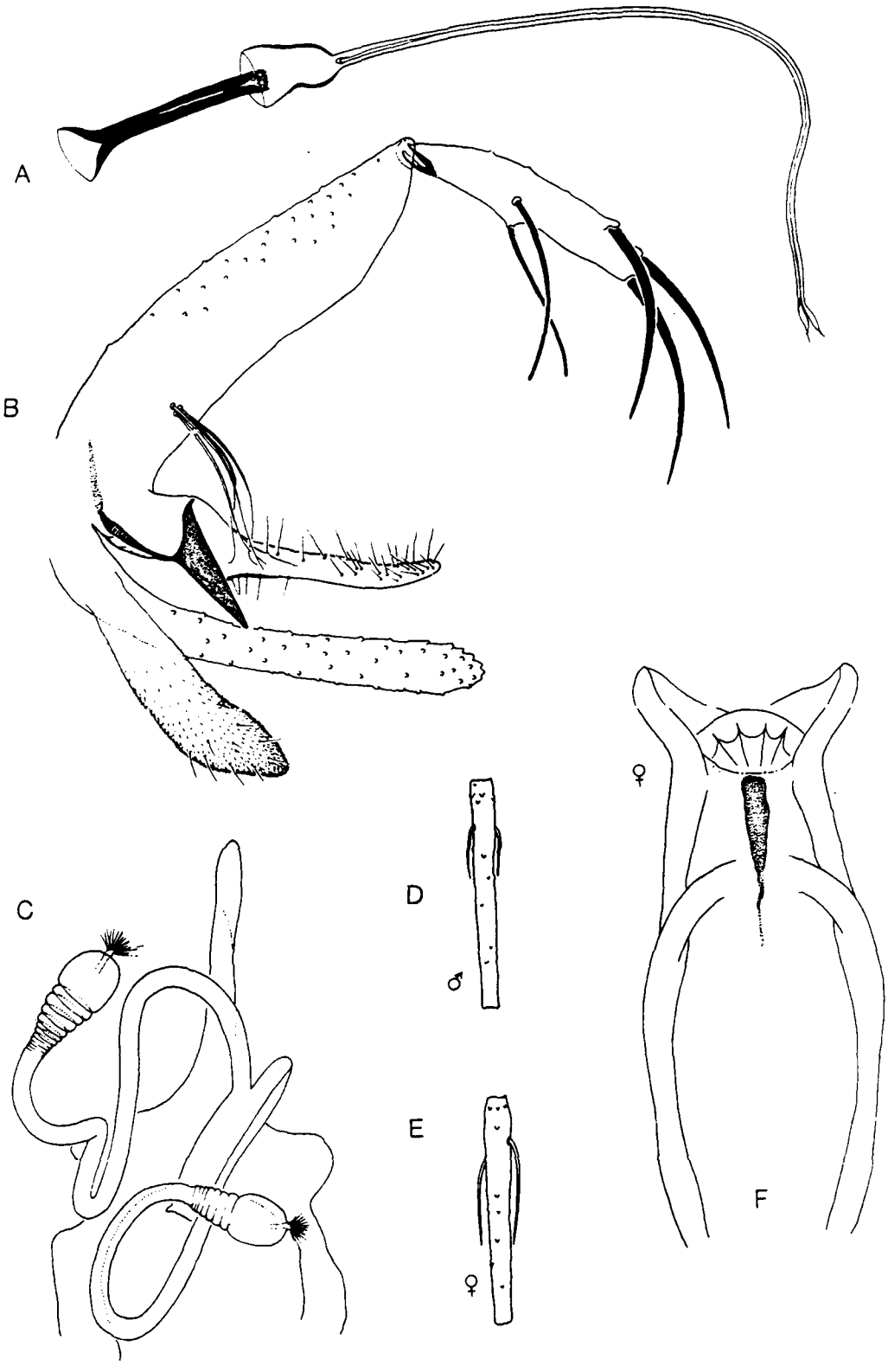



Plate 37-16

Lutzomyia stewarti. A. Genital pump & *filaments*; B. Male terminalia; C. Spermathecae; D. Male flagellomere II; E. Female flagellomere II; F. Female cibarium (from Young & Perkins 1984).

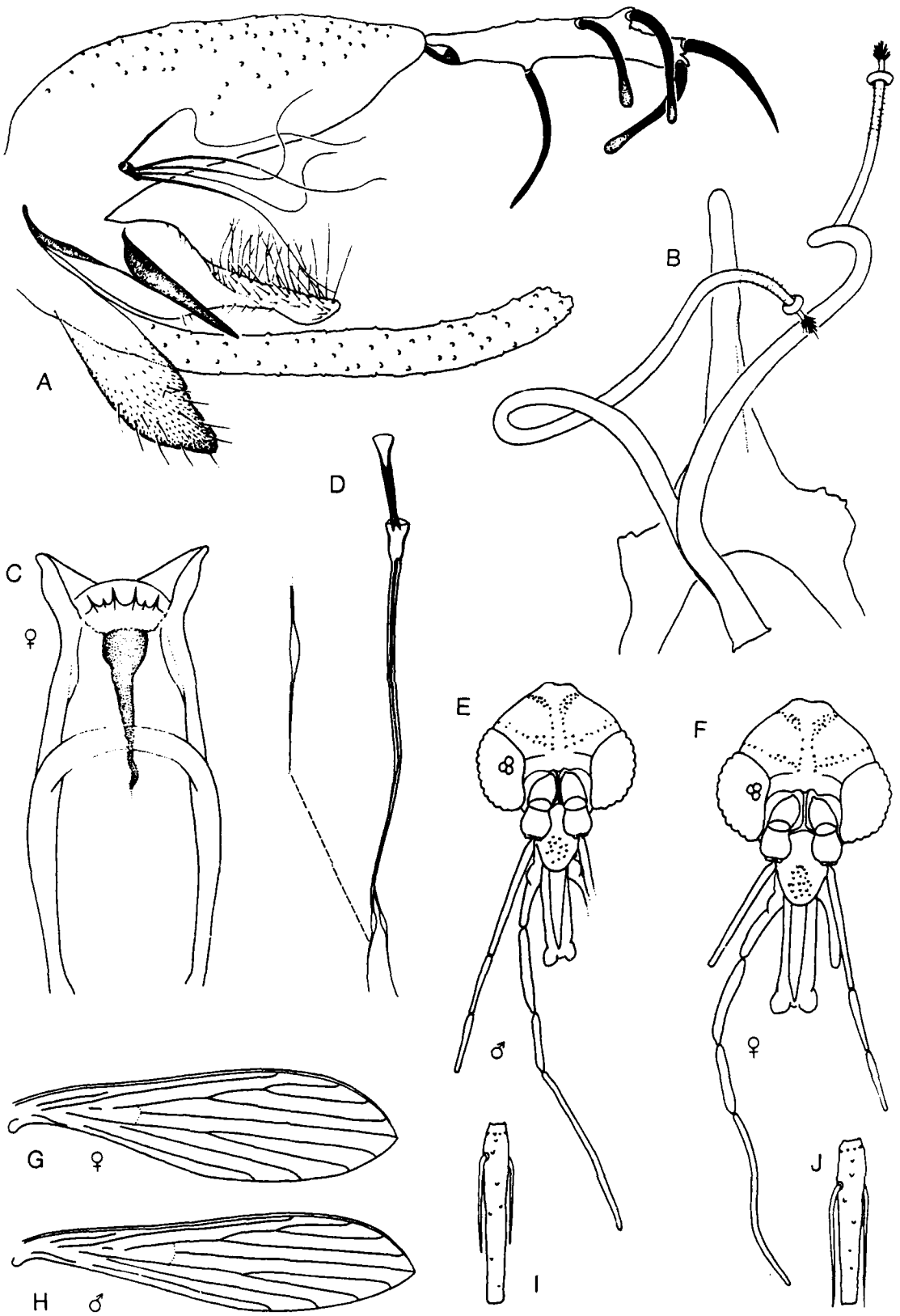



Plate 37-17

Lutzomyia vexator. A. Male terminalia; B. Spermathecae; C. Female cibarium; D. Genital pump & filaments; E. Male head; F. Female head; G. Female wing; H. Male wing; I. Male flagellomere II; J. Female flagellomere II (figs. from Young & Perkins 1984).

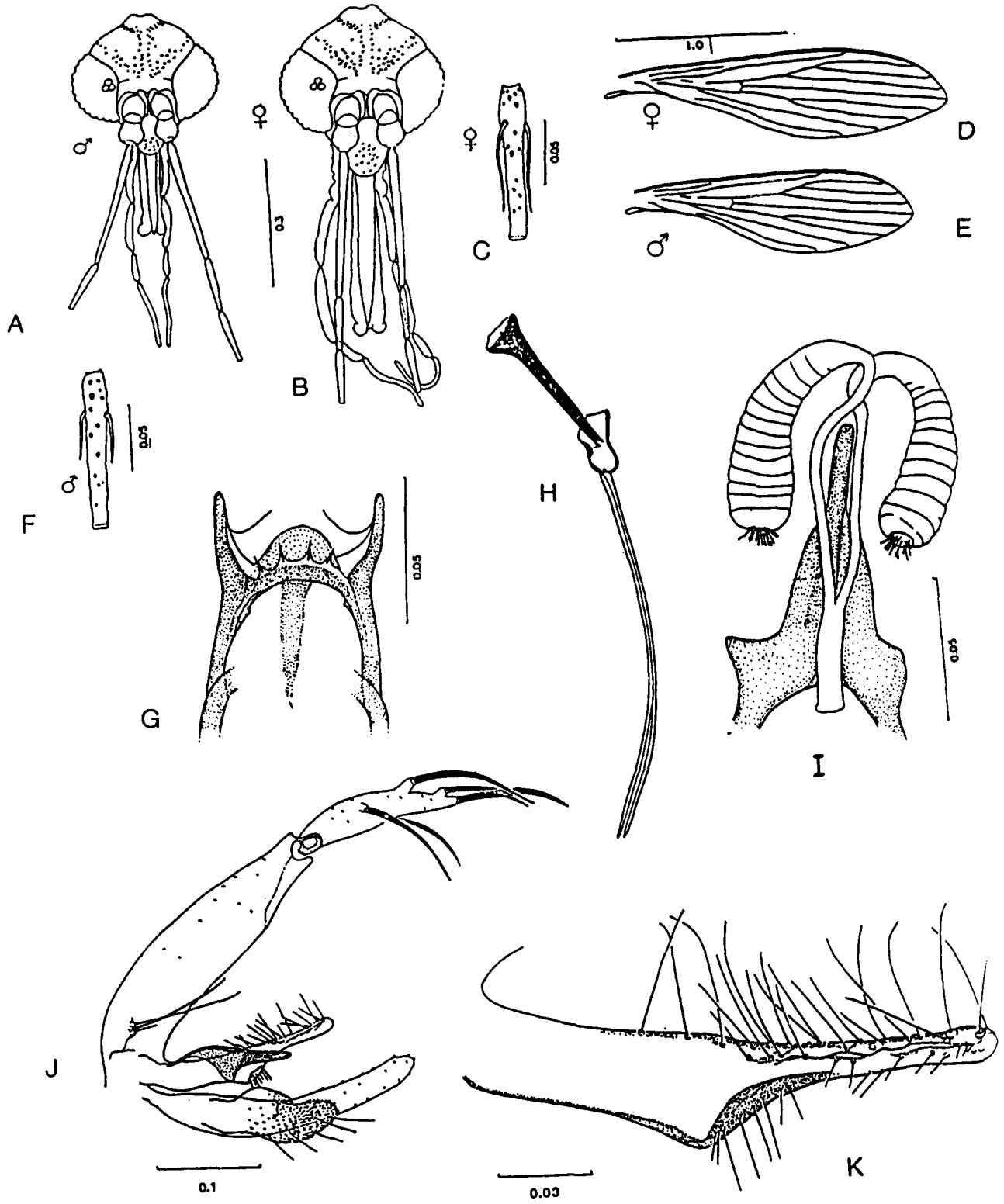



Plate 37-18

Lutzomyia sanguinaria. A. Male head; B. Female head; C. Female flagellomere II; D. Female wing; E. Male wing; F. Male flagellomere II; G. Female cibarium; H. Genital pump & filaments; I. Spermathecae; J. Male terminalia; K. Paramere (from Young 1979).

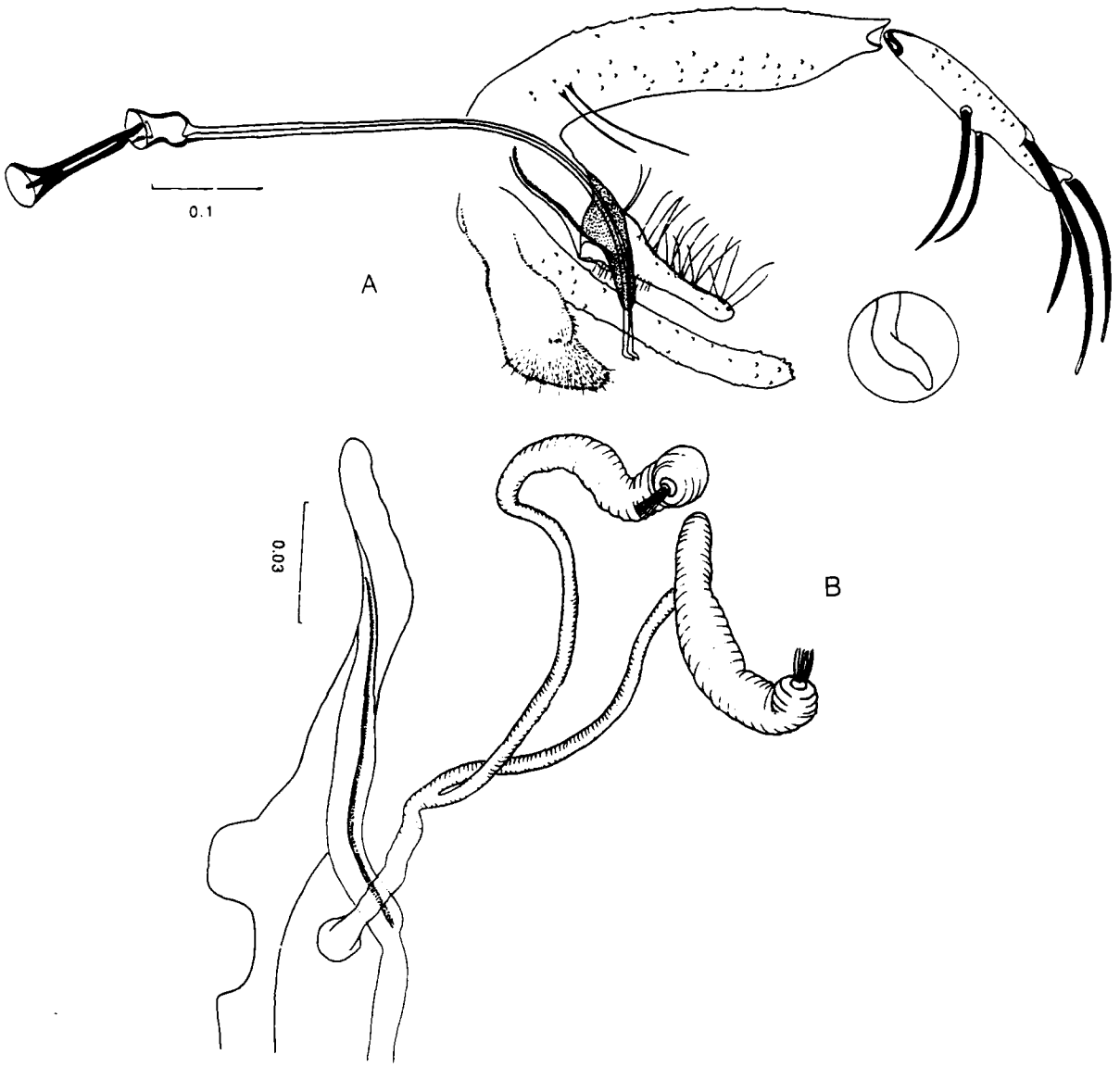



Plate 37-19

Lutzomyia sanguinaria (variant). A. Male terminalia; B. Spermathecae (specimens from La Fortuna, Chiriqui Prov., Panama).

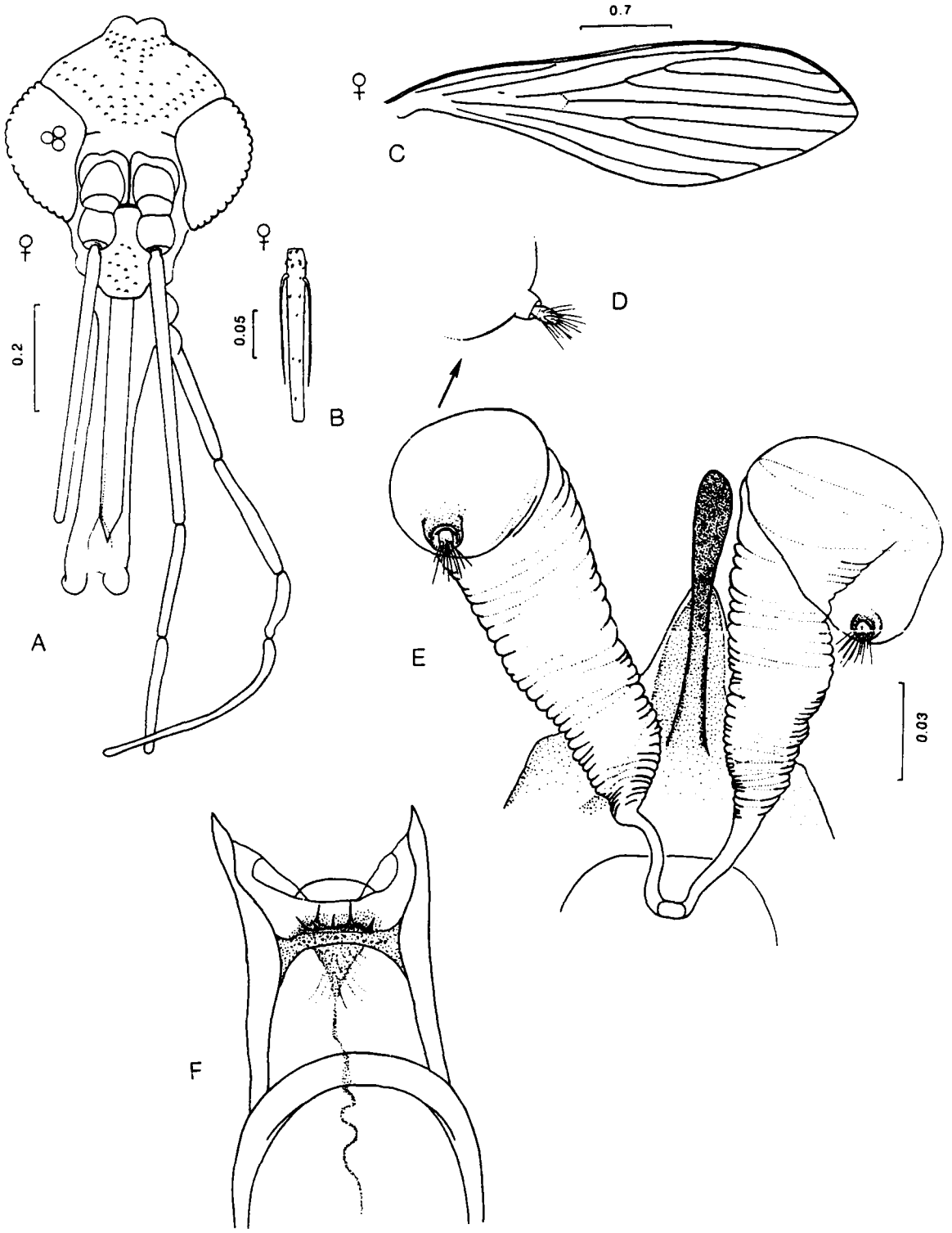



Plate 37-20

Lutzomyia botella. A. Female head; B. Female flagellomere II; C. Female wing; D. End of spermatheca; E. Spermathecae; F. Female cibarium.

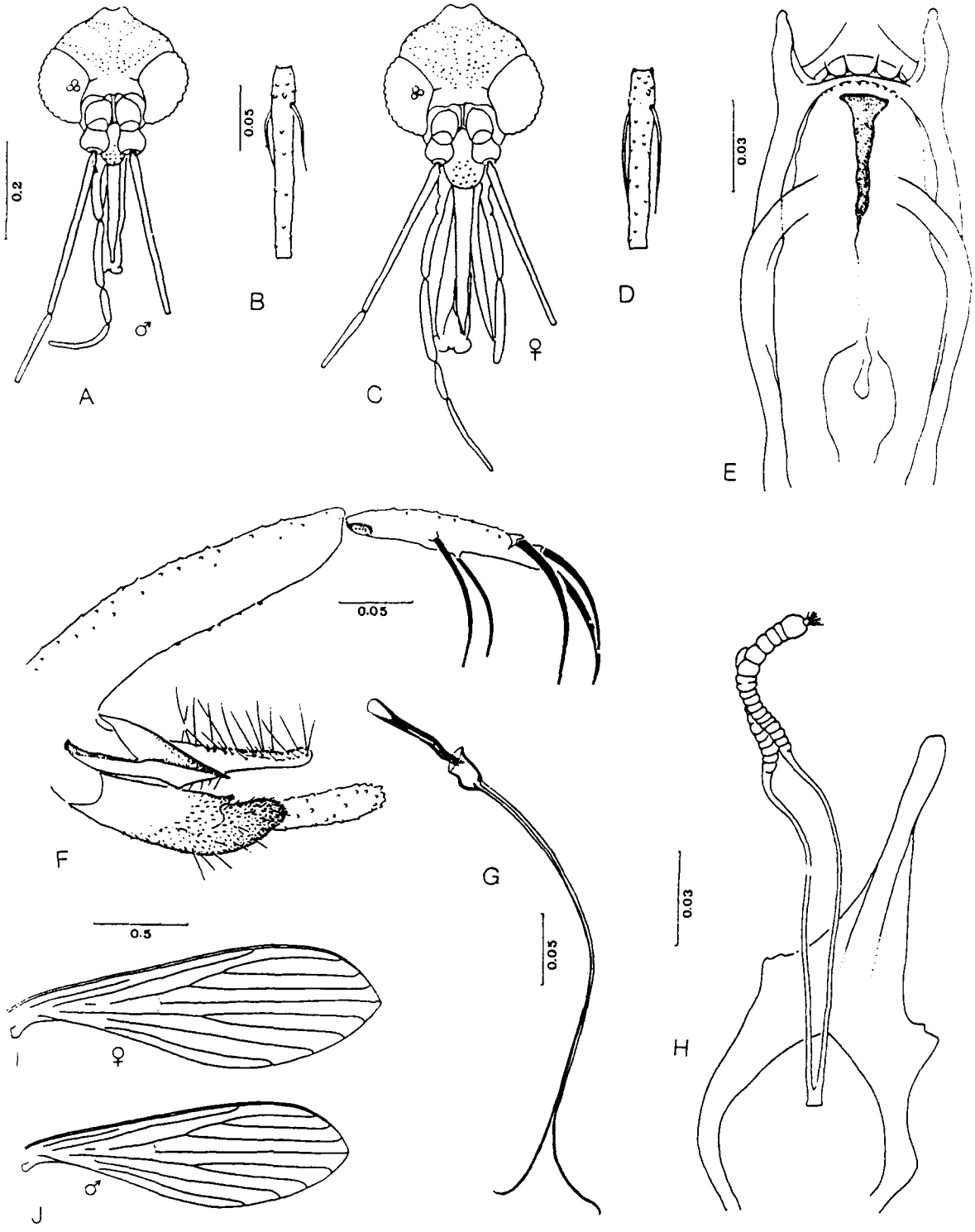



Plate 37-21

Lutzomyia tortura. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium; F. Male terminalia; G. Genital pump & filaments; H. Spermathecae; I. Female wing; J. Male wing (from Young & Rogers 1984).

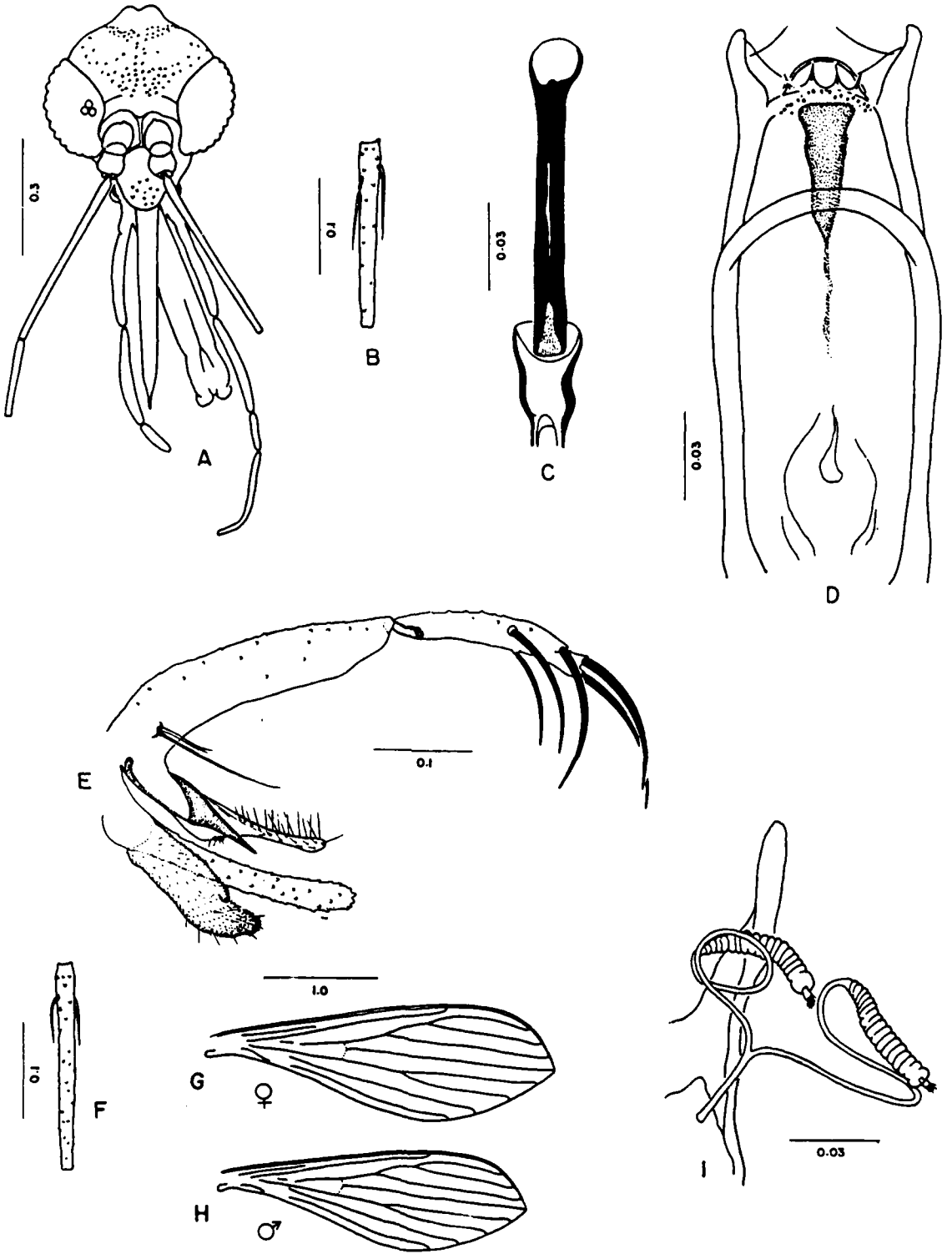



Plate 37-22

Lutzomyia scorzai. A. Female head; B. Female flagellomere II; C. Genital pump: D. Female cibarium; E. Male genitalia; F. Male wing; G. Female wing; H. Male wing; I. Spermathecae (from Young 1979).

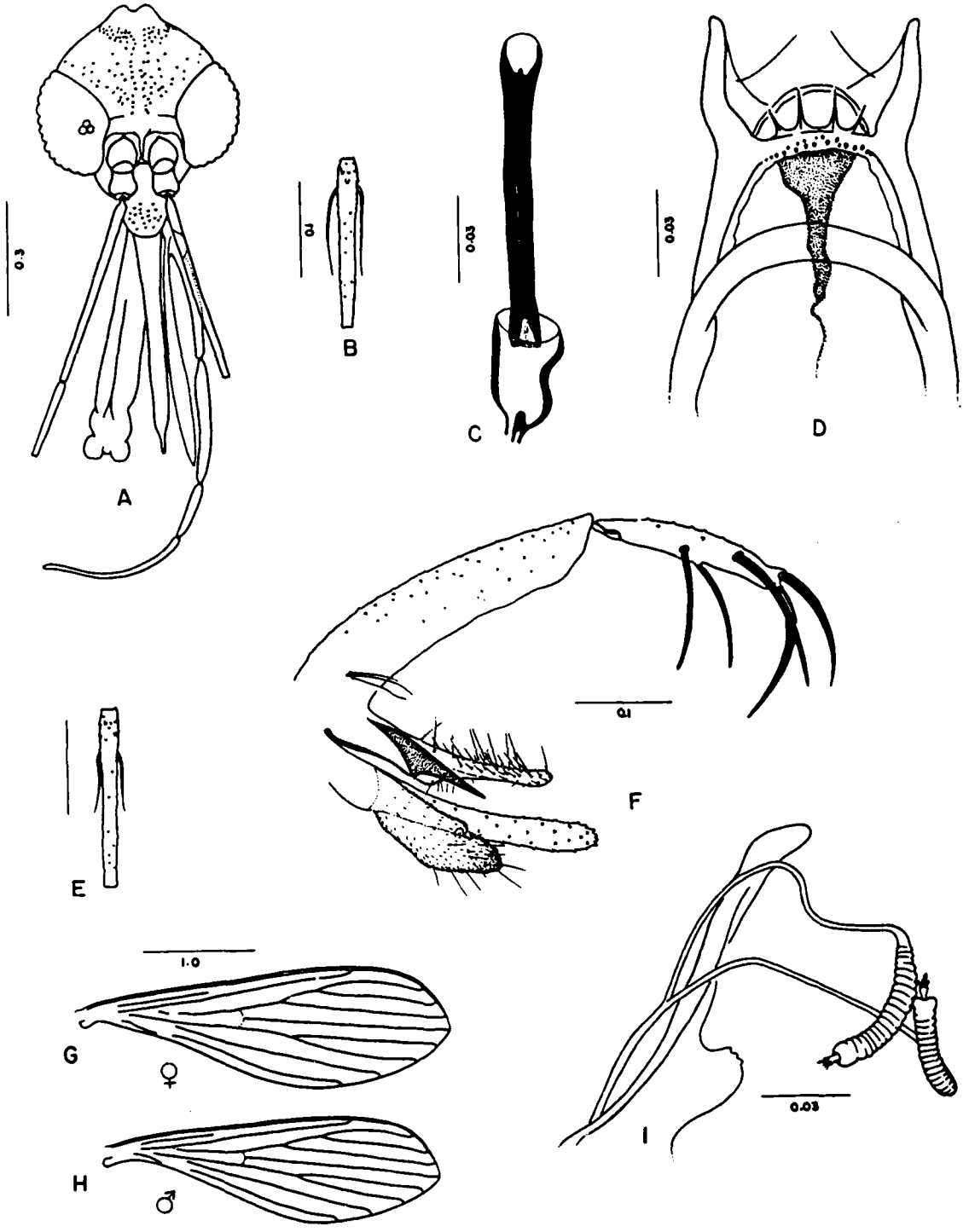



Plate 37-23

Lutzomyia sp. of Pichinde. A. Female head; B. Female flagellomere II; C. Genital pump; D. Female cibarium; E. Male flagellomere II; F. Male genitalia; G. Female wing; H. Male wing; I. Spermathecae (from Young 1979).

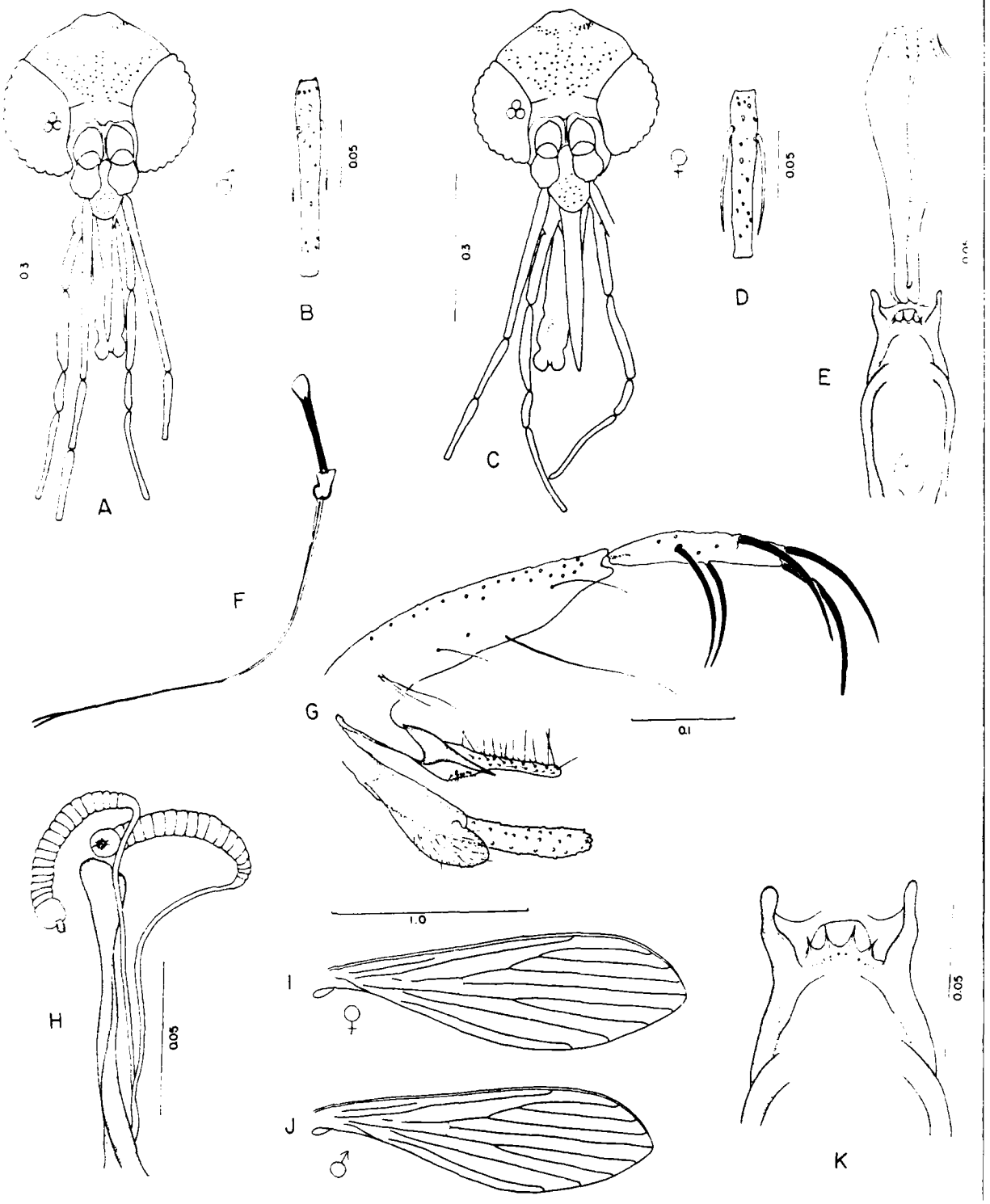
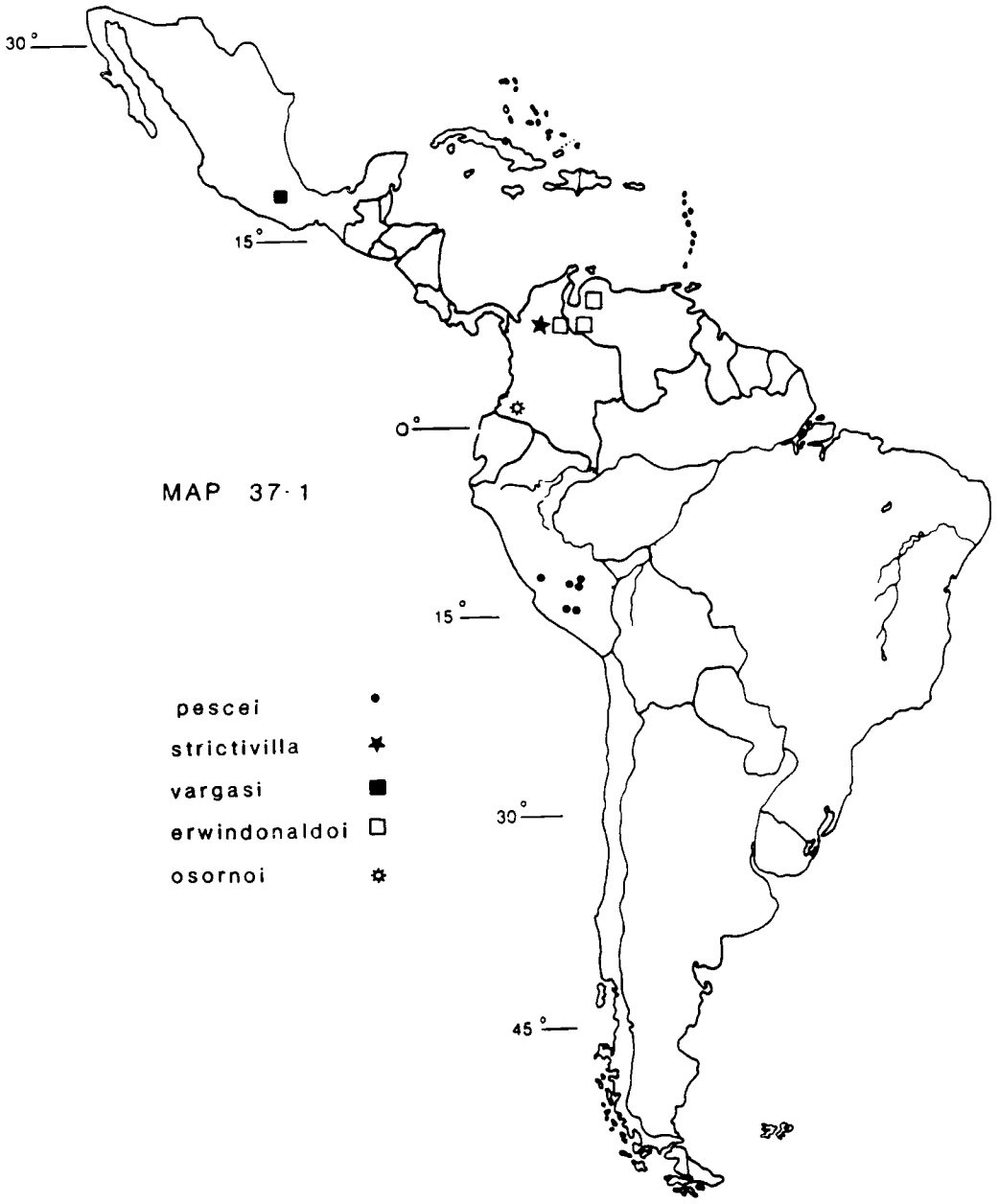
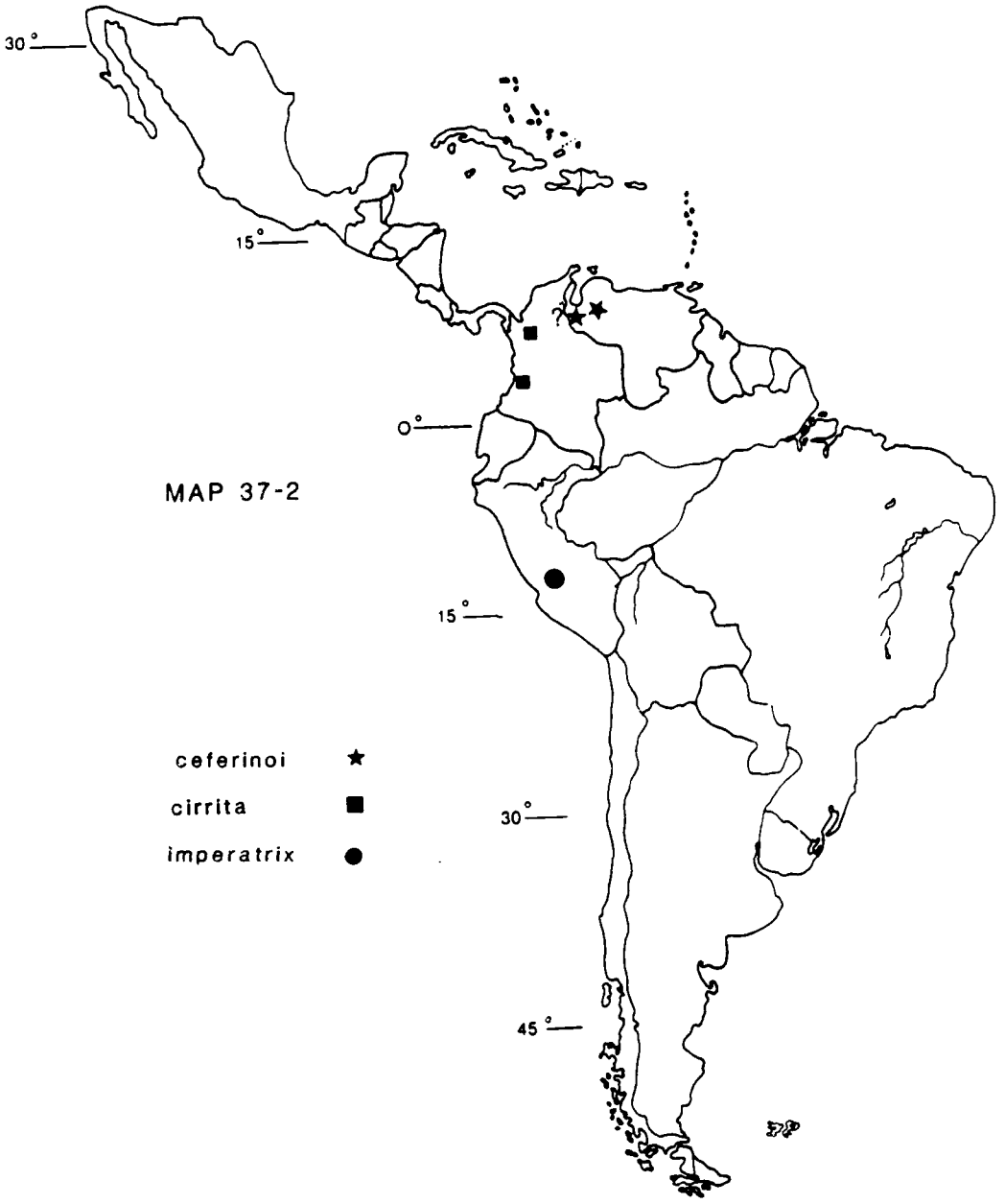



Plate 37-24

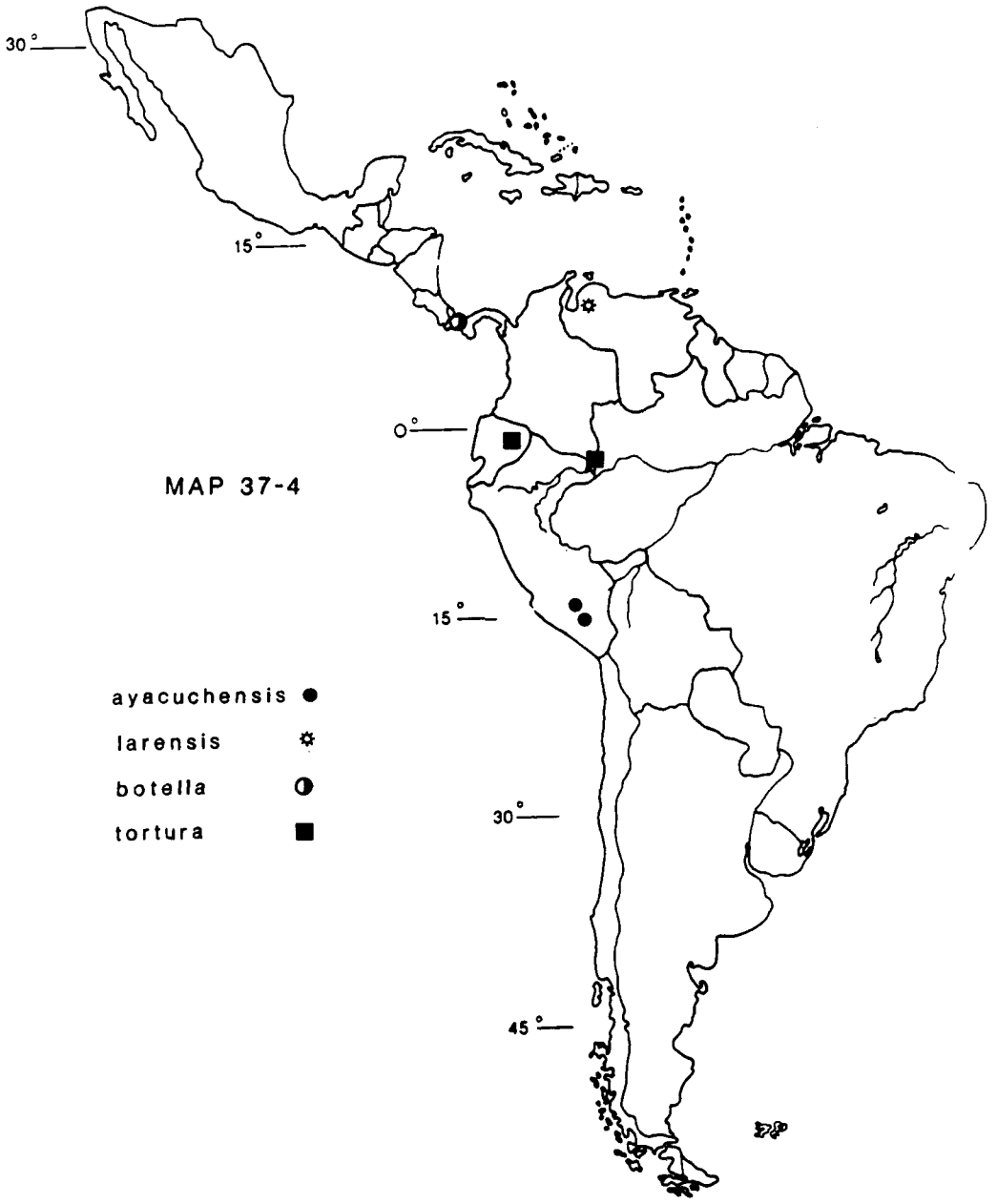
Lutzomyia hartmanni. A. Male head; B. Male flagellomere II; C. Female head; D. Female flagellomere II; E. Female cibarium & pharynx; F. Genital pump & filaments; G. Male terminalia; H. Spermathecae; I. Female wing; J. Male wing; K. Female cibarium (from Young 1979).

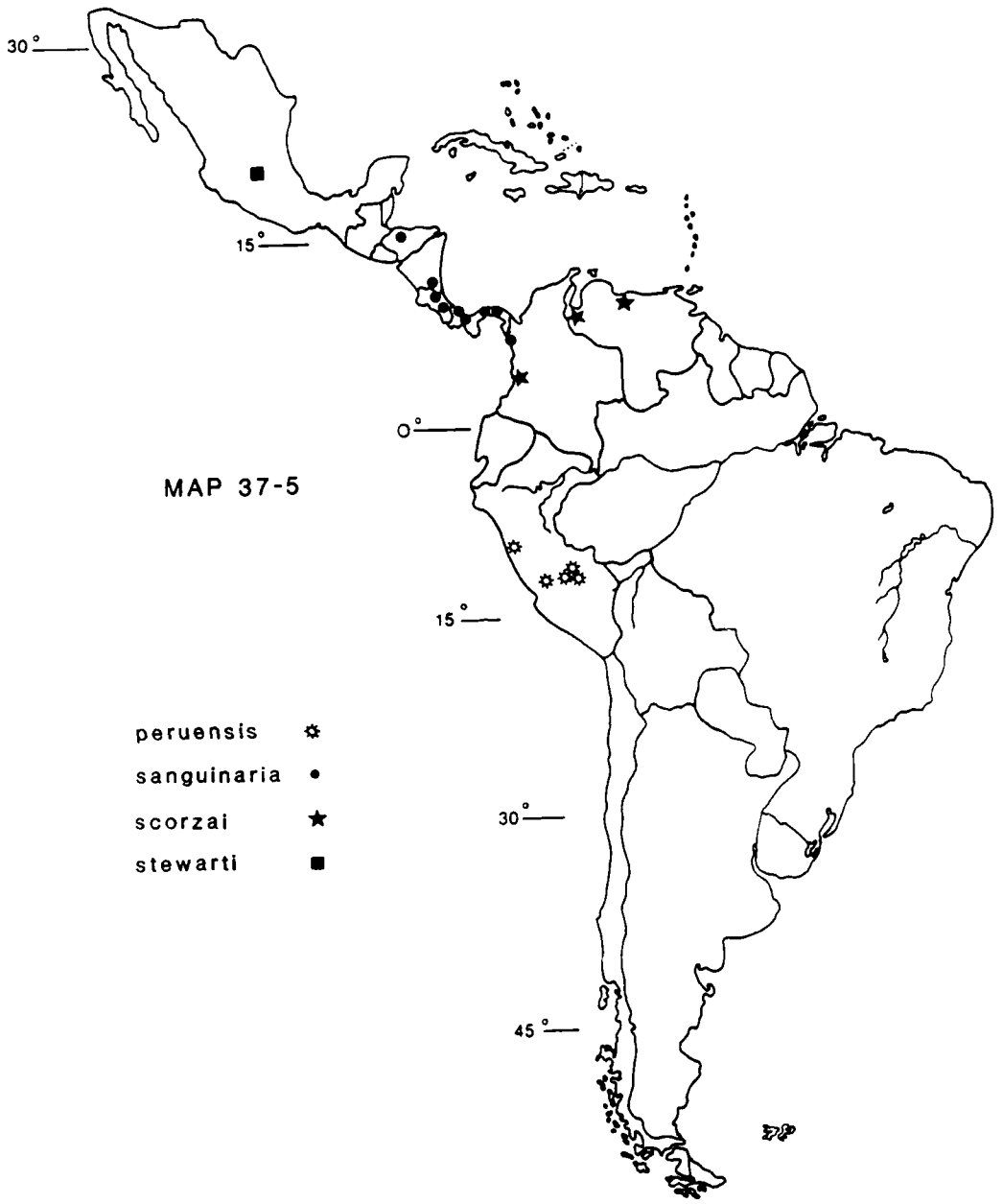

30°
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pescei
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MAP 37·1

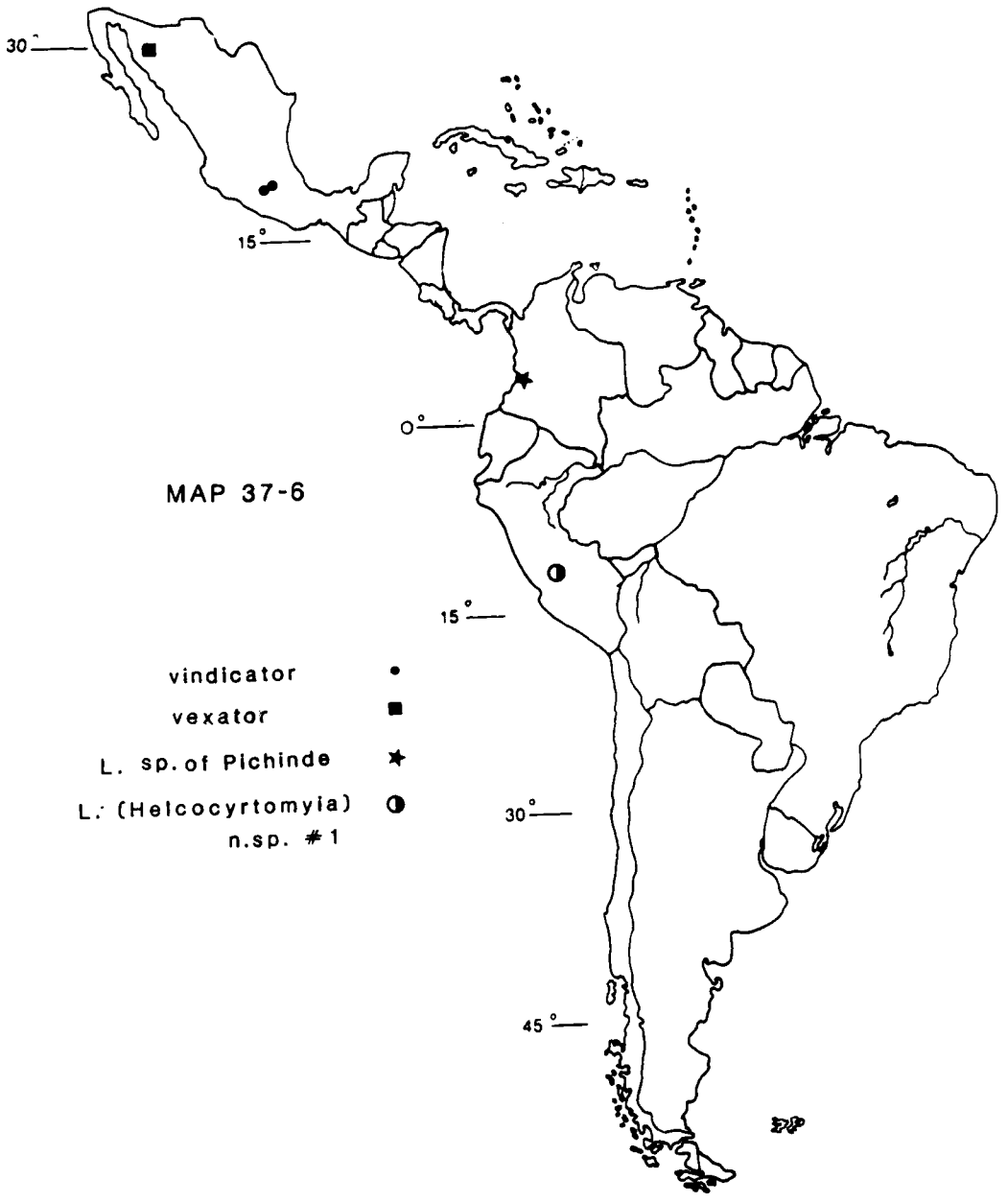

30°
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MAP 37-2
ceferinoi
cirrita
imperatrix


30°
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15°
30°
45°
MAP 37-3
hartmanni
noguchii
oppidana


30°
15°
0°
15°
30°
45°
MAP 37-4
ayacuchensis
larensis
botella
tortura




MAP 37-5


30°
15°
0°
15°
30°
45°
MAP 37-6
vindicator
vexator
L. sp. of Pichinde
L. (Helcocyrtomyia) n.sp. #1

## 38. Ungrouped Lutzomyia Species

The following species cannot be placed in existing species groups or subgenera because of: 1) unusual combinations of character states; 2) existing specimens are damaged, or 3) because only one sex is known.

Medical Importance: Unknown; several species have been reported biting man.

### Lutzomyia monticola (Costa Lima)

Plate 38-1

Phlebotomus monticolus Costa Lima 1932: 50 (♀, Serra da Bocaina, São Paulo, Brazil). Barretto & Coutinho 1941a: 177 (♂ descript.). Floch & Abonnenc 1952: 16 (keyed, ♀ figs.). Bejarano 1959: 817 (dist., Argentina).

Flebotomus monticolus: Barretto 1947a: 213 (refs.); 1950a: 110 (keyed, ♀ fig.).

Lutzomyia monticola: Theodor 1965: 196 (?, in part). Martins et al. 1977a: 135 (cf. to paulwilliamsi); 1978: 165 (refs., dist.). Aguiar & Soucasaux 1984: 199 (human bait collections, Brazil). Aguiar et al. 1985a; b; c; 1986 (coll. data, habits, Brazil).

Psychodopygus monticolus: Forattini 1971a: 105 (listed); 1973: 474 (tax., figs.).

Distribution (Map 38-1). Argentina: Brazil (Martins et al. 1978).

Remarks. Aguiar et al. (1986) collected females of L. monticola from human and chicken bait in southern Brazil.

Theodor (1965) wrote that the male of L. monticola has a small subapical seta on the style, but he may have been observing the male of L. paulwilliamsi, a closely related species that does, indeed, have such a seta, unlike L. monticola.

These two species and L. misioneneis may eventually be placed in their own species or subgenus.

Lutzomyia paulwilliamsi Martins, Falcão & Silva

Plate 38-1

Lutzomyia paulwilliamsi Martins, Falcão & Silva 1977a: 135 (♂, Botanical Garden, Federal University of Minas Gerais, Belo Horizonte, Minas Gerais, Brazil). Martins et al. 1978: 166 (dist.). Mayrink et al. 1979: 134 (Minas Gerais, Brazil).

Distribution (Map 38-2). Brazil (Martins et al. 1978); Paraguay (1 ♂, Acá Poi, San Pedro, animal burrow, 20 April 1950, M. Hertig).

Remarks. The male of L. paulwilliamsi closely resembles that of L. monticola but, according to Martins et al. (1977a), the latter species lacks a subapical seta of the style and persistent setae on the coxite. The

female is known but undescribed (Martins et al. 1978). One male from Petropolis, Rio de Janeiro, Brazil, and identified by M.P. Barretto as L. monticola, represents L. paulwilliamsi instead. This suggests that some or many previous records of L. monticola are misidentifications or else that the species are conspecific, the observed variation being infraspecific.

## Lutzomyia misionensis (Castro)

Plate 38-2

Flebotomus misionensis Castro 1959a: 331 (♀, Cerro Azul, Misiones, Argentina).

Flebotomus sp. Bejarano & Duret 1950: 327 (biting man, Cerro Azul, Argentina).

Lutzomyia coelhoi Coelho, Falcao & Falcao 1967a: 179 (nomen nudum, no description or figures given).

Lutzomyia misionensis: Forattini 1973: 354 (♀ fig.). Martins et al. 1977b: 569 (♂, ♀ figs., dist.); 1978: 165 (refs., dist.).

Distribution (Map 38-3). Argentina; Brazil (Martins et al. 1978).

## Lutzomyia pia (Fairchild & Hertig)

Plate 38-3

Phlebotomus pius Fairchild & Hertig 1961b: 248 (♂, ♀, Chiriqui, Panama).

Lutzomyia pia: Theodor 1965: 187 (listed). Martins et al. 1978: 166 (dist.). Young 1979: 223 (figs., refs.). Ramirez Perez et al. 1982b: 58 (keyed, figs., Venezuela). Murillo & Zeledón 1985: 117 (figs., Costa Rica). Young et al. 1987: 588 (Norte de Santander, Colombia).

Distribution (Map 38-4). Costa Rica (Murillo & Zeledón 1985); Panama (Martins et al. 1978); Colombia (Young 1979; Young et al. 1987); Venezuela (Ramirez Perez et al. 1982b).

Remarks. This anthropophilic species has been included with the oswaldoi group species in the past [e.g., Theodor (1965), Young (1979), & Murillo & Zeledón (1985)] based mainly on the 5-spined style of the male. However, other character states, such as the short palpomere 5, verrucarum-like spermathecae, presence of a subapical seta on the style and complete cibarial arch of the female, suggest that L. pia is more closely allied with the verrucarum group species.

## Lutzomyia bursiformis (Floch & Abonnenc)

Plate 38-4

Phlebotomus bursiformis Floch & Abonnenc 1944c: 5 (♀, Baduel, French Guiana); 1952: 183 (duplicate description, figs.).

Lutzomyia bursiformis: Theodor 1965: 196 (listed). Forattini 1973: 251 (♀ fig.). Leger et al. 1977: 219 (French Guiana). Martins et al. 1978: 161 (listed). Lebbe et al. 1987: 30 (computer aided ident.).

Distribution (Map 38-3). French Guiana (Floch & Abonnenc 1944c; ♀♀, Paramana, Nov.-Dec. 1980, M. Claustre).

Remarks. Through the courtesy of L.P. Dedet, we examined 3 females of L. bursiformis from Paramana, French Guiana, taken while biting man. This species is easily identified by the enormous sac-like spermathecae. The male remains unknown.

## Lutzomyia rangeliana (Ortiz)

Plate 38-5

Phlebotomus rangelianus Ortiz 1952: 153 (♂, Duaca, Lara, Venezuela). Pifano et al. 1962c: 384 (♂, ♀, keyed, figs.).

Lutzomyia rangeliana: Theodor 1965: 196 (listed). Martins et al. 1978: 166 (refs., dist.). Ramirez Perez et al. 1978: 52 (♂, ♀ figs., Aragua, Venezuela); 1982a: 14; 1982b: 58 (tax., Venezuela). Young 1979: 235 (♂, ♀ figs., refs.). Feliciangeli 1980: 246 (figs., keyed). Feliciangeli et al. 1984a: 360 (Venezuela). Feliciangeli 1987a: 122; 1987b: 127 (Carabobo, Venezuela).

Distribution (Map 38-5). Colombia (Young 1979); Venezuela (Martins et al. 1978; Ramirez Perez et al. 1978; 1982a,b; Feliciangeli et al. 1984a; Feliciangeli 1987a,b); Trinidad; Panama (Young 1979).

Remarks. According to Ortiz (1968), cited by Feliciangeli (1980), females of L. rangeliana feed on bats and armadillos. Both sexes of this species resemble some species in the verrucarum group (Young 1979).

## Lutzomyia ignacioi Young

Plate 38-6

Lutzomyia ignacioi Young 1972a: 312 (♂, ♀, 2 km S of Merida, Merida, Venezuela). Feliciangeli 1980: 246 (keyed, figs.). Young & Morales 1987: 662 (Granada, Colombia).

Distribution (Map 38-6). Venezuela (type locality); Colombia (Young & Morales 1987).

Remarks. Lutzomyia ignacioi has been found only at high elevations ( >2000 M above sea level) in cloud forests in Venezuela and Colombia. Its nearest living relatives appear to be those in the subgenus Psathyromyia, but the male has persistent setae on each coxite.

## Lutzomyia ponsi Laneti

Plate 38-7

Lutzomyia ponsi Laneti 1984. Kasmera 12: 130 (♀, El Tama National Park, Tachira, Venezuela).

Distribution (Map 38-7). Venezuela (type locality).

Remarks. Lutzomyia ponsi females were captured in a Shannon trap operated in a mountain forest, 2200 M above sea level. Based on the original description only, this species and L. ignacioi are closely allied but the L. ponsi female has 8, not 4, horizontal teeth in the cibarium. Both species are exceptionally large sand flies.

## Lutzomyia torrealbai Martins, Fernandez & Falcão

Plate 38-7

Lutzomyia torrealbai Martins, Falcão & Silva 1979b: 431 (♂, Vitisay, Trujillo, Venezuela).

Distribution (Map 38-8). Venezuela (Martins et al. 1979b).

Remarks. The male has 5-6 spines on the style and a subterminal seta, the presence of which is unusual among 5-spined Lutzomyia males.

## Lutzomyia brisolai Le Pont & Desjeux

Plate 38-7

Lutzomyia brisolai Le Pont & Desjeux 1987b: 319 (♂, ♀, Serrania de Marimonos, Alto Beni, La Paz, Bolivia).

Distribution (Map 38-6). Bolivia (type locality).

Remarks. Like many females in the subgenus Nyssomyia, that of L. brisolai is anthropophilic but there are only four horizontal teeth in the cibarium. The spermathecae and most other character states are similar to those in that subgenus but, for the present, this species is regarded as ungrouped.

## Lutzomyia Species of Anchicaya Young

Plate 38-8

Lutzomyia sp. of Anchicaya Young 1979: 237 (♂, Anchicaya Dam, Valle, Colombia).

Distribution (Map 38-8). Colombia (Young 1979); Ecuador (1 ♂, 12 km E of Santo Domingo de Los Colorados, Pichincha, July 1982, D. Duckhouse).

Remarks. A second male of this informally named taxon from Ecuador closely resembles the male from Colombia (Young 1979). Its assignment to a species group and full description must await the discovery of the female.

## Lutzomyia acanthopharynx Martins, Falcao & Silva

Plate 38-9

Lutzomyia acanthopharynx Martins, Falcão & Silva 1962d: 387 (♂, ♀, Formosa, Goias, Brazil). Theodor 1965: 195. Forattini 1973: 300 (tax., figs.). Lainson et al. 1976: 57 (Mato Grosso, Brazil). Martins et al. 1978: 160 (refs., dist.). Arias et al. 1985: 1101 (neg. for flagellates, Brazil).

Distribution (Map 38-7). Brazil (Lainson et al. 1976; Martins et al. 1978).

Remarks. The spermathecae of L. acanthopharynx resemble those of some oswaldoi group females, but the male has only 4 large spines on the style. The heavily spined pharynx is characteristic.

## Lutzomyia samueli (Deane)

Plate 38-10

Phlebotomus samueli Deane 1955. Rev. Hospital Clin. 10: 251 (♂, Pé da Serra, Massapé, Ceará, Brazil). Deane & Deane 1957: 231 (coll. data, Ceará, Brazil).

Lutzomyia samueli: Theodor 1965: 193 (mention). Forattini 1971a: 100; 1973: 332 (♂ fig., tax., refs.). Martins et al. 1978: 167 (dist.).

Distribution (Map 38-8). Brazil (Martins et al. 1978).

Remarks. The arrangement of the spines on the style and distinctive paramere serve as diagnostic characters for this species. Forattini (1973) places L. samuel in the subgenus Dampfomyia, but its definite status cannot be determined until the female is discovered.

Lutzomyia boliviana Velasco & Trapido

Plate 38-11

Lutzomyia boliviana Velasco & Trapido 1974: 433 (♂, ♀, Rio Solacama, La Paz, Bolivia). Martins et al. 1978: 161 (listed).

Distribution (Map 38-1). Bolivia (type locality).

Remarks. Lutzomyia boliviana has no known close relatives. Both sexes have a unique combination of character states.

Lutzomyia oligodonta Young, Perez & Romero

Plate 38-12

Lutzomyia oligodonta Young, Perez & Romero 1985: 136 (♂, ♀, Cocachacra, Lima, Peru).

Distribution (Map 38-1). Peru (type locality).

Remarks. The female of L. oligodonta lacks a distinct cibarial armature, unlike other Lutzomyia females. This character state, when viewed in

combination with other features of both sexes (Young et al. 1985), indicates that this species has no close allies in the genus.

Lutzomyia (ungrouped) n.sp. #1

Plate 38-13

Distribution (Map 38-2). Mexico (1 ♂, 2 ♀♀, Miacatalan, Morelos, flight trap, May 1980, M. Camino).

Remarks. This small eyed species may belong in the subgenus Coromyia but the only available male lacks styles, lateral lobes and other structures. The tips of the genital filaments are expanded to a greater degree than any other described Lutzomyia species. These expansions correspond to the relatively wide sperm ducts of the female. The cibarial armature of the female includes 6 horizontal teeth, unlike known females in the subgenus Coromyia. The lateral teeth are well developed, conspicuous.




Plate 38-1

Lutzomyia monticola. A. Paramere; B. Genital pump, filaments & aedeagus; C. Style (figs. from Barretto & Coutinho 1941a).

Lutzomyia paulwilliamsi. D. Male terminalia; E. Paramere; F. Genital pump & filaments; G. Female cibarium; H. Female head; I. Spermathecae.

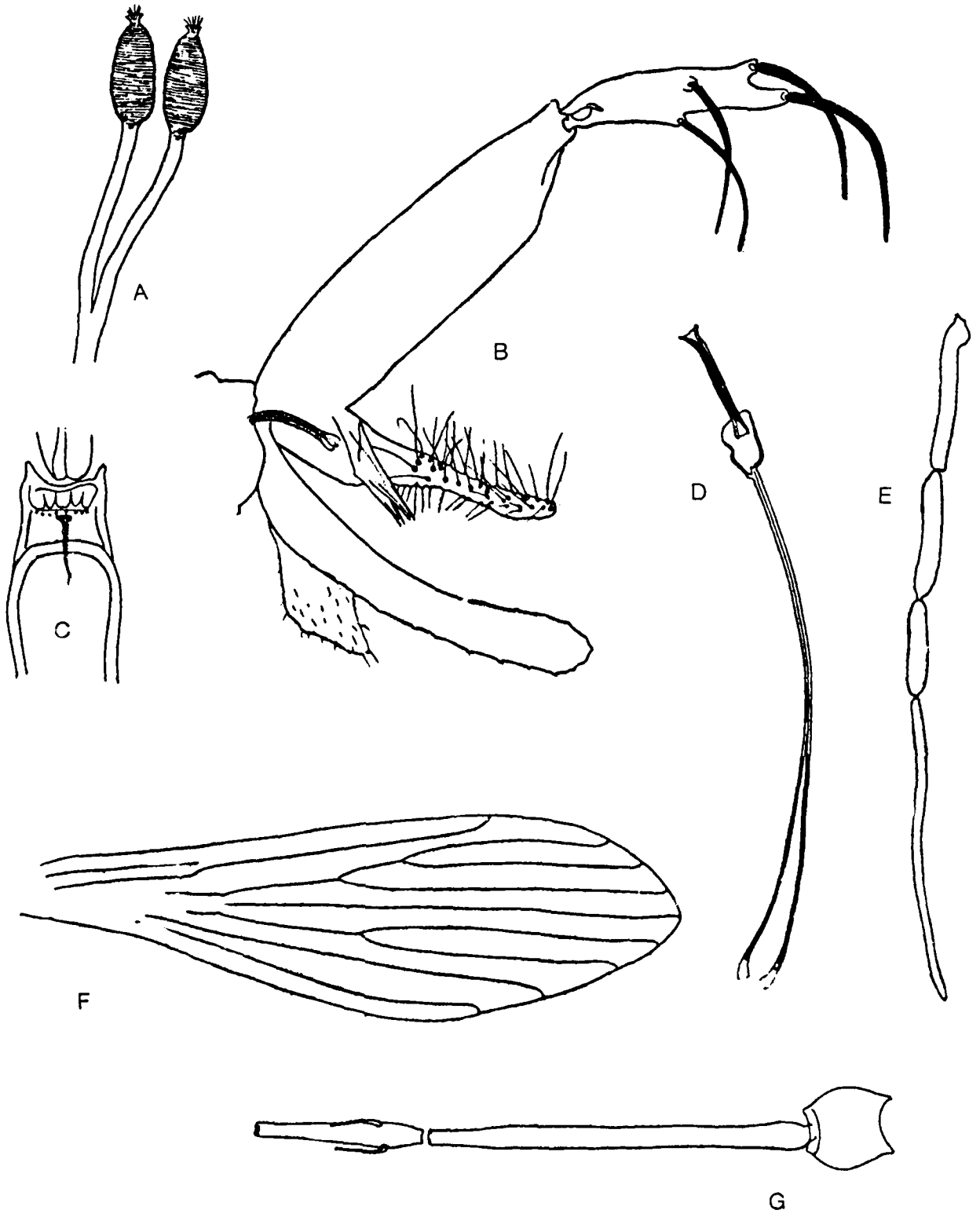



Plate 38-2

Lutzomyia misionensis. A. Spermathecae; B. Male terminalia; C. Female cibarium; D. Genital pump & filaments; E. Male palpus; F. Female wing; G. Male pedicel & flagellomeres 1 & 11 (figs. from Martins et al. 1977b).

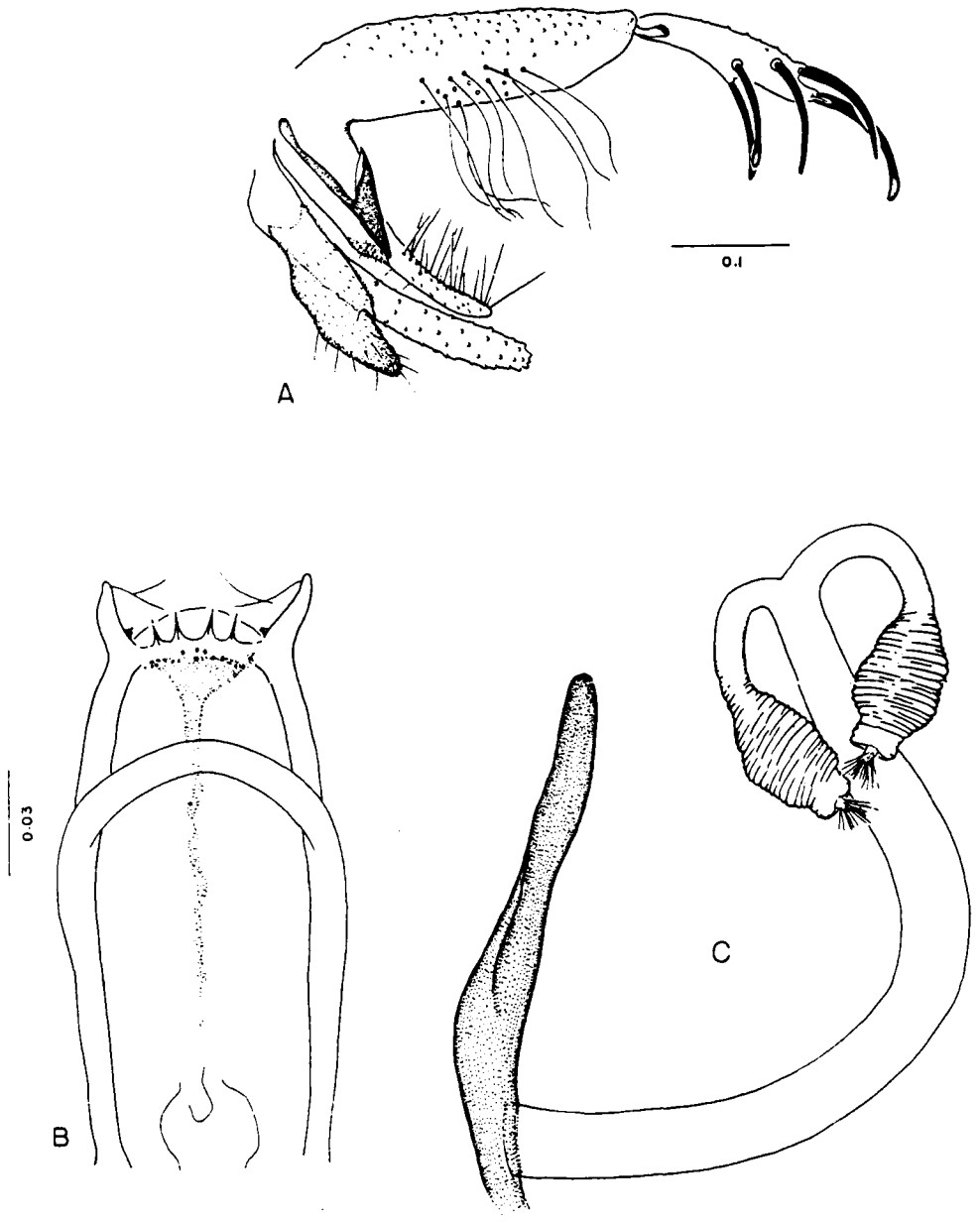



Plate 38-3

Lutzomyia pia. A. Male terminalia; B. Female cibarium; C. Spermathecae (figs. A & B from Young 1979).

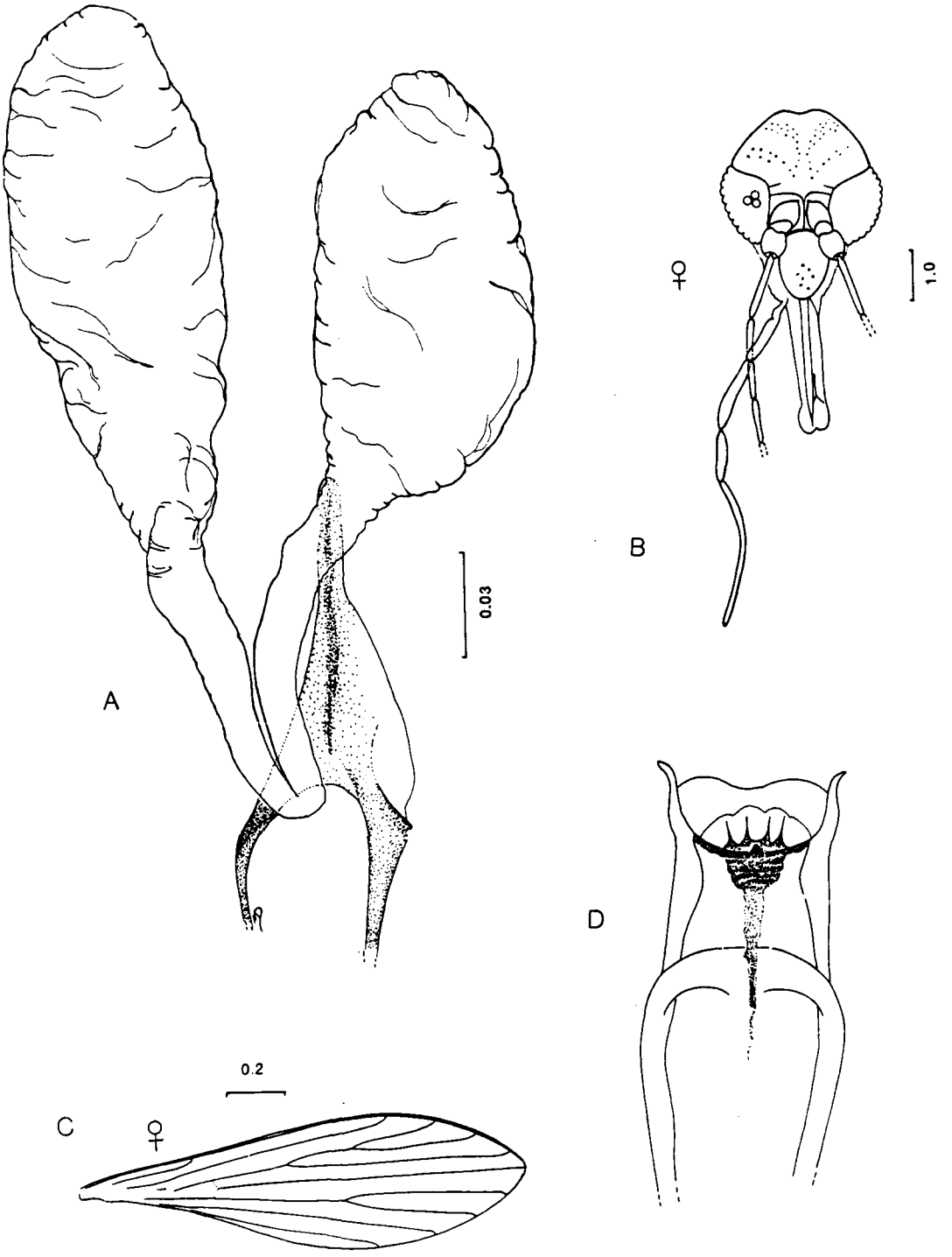



Plate 38-4

Lutzomyia bursiformis. A. Spermathecae; B. Female head; C. Female wing; D. Female cibarium.

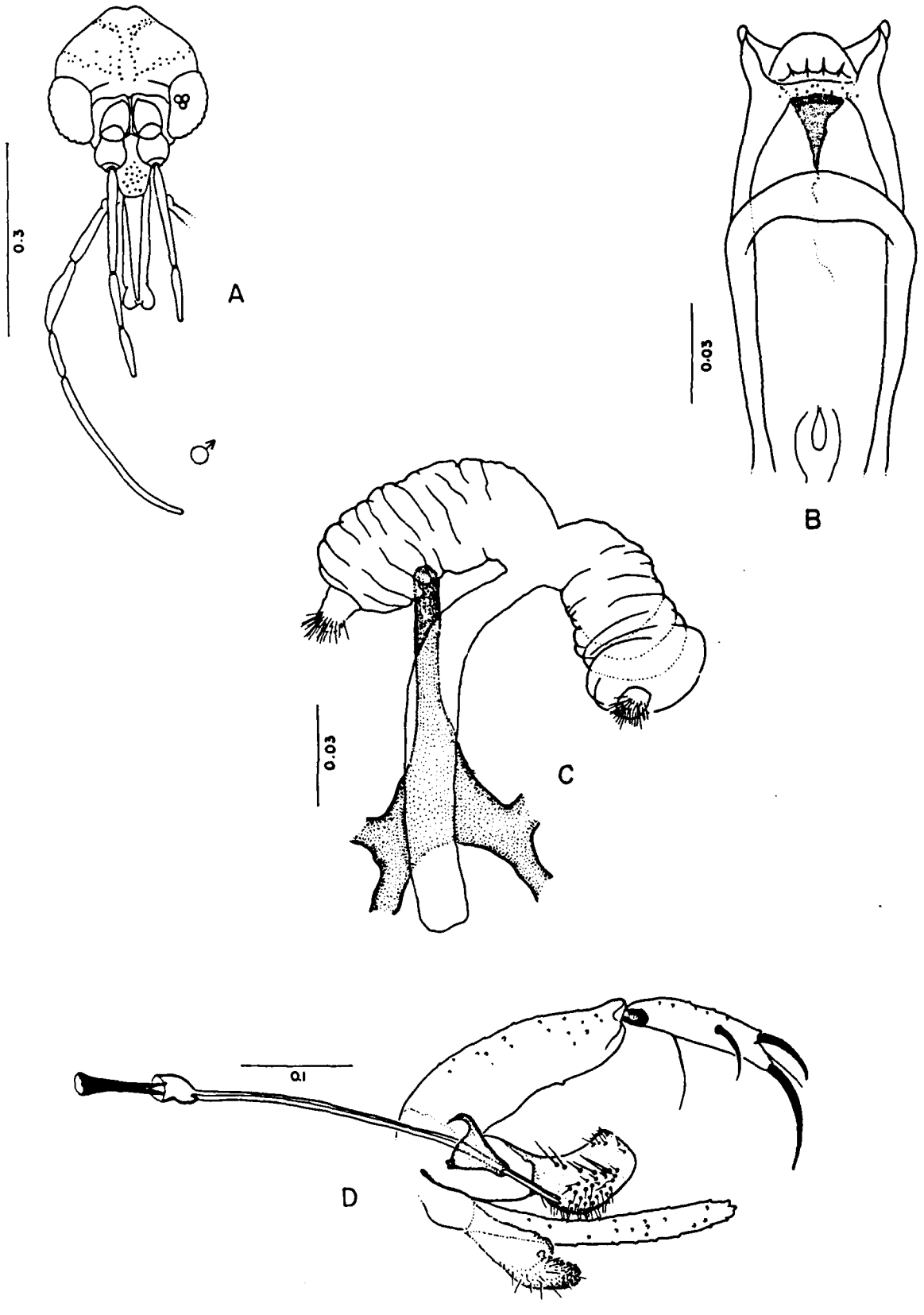



Plate 38-5

Lutzomyia rangeliana. A. Male head; B. Female cibarium; C. Spermathecae; D. Male terminalia; (from Young 1979).

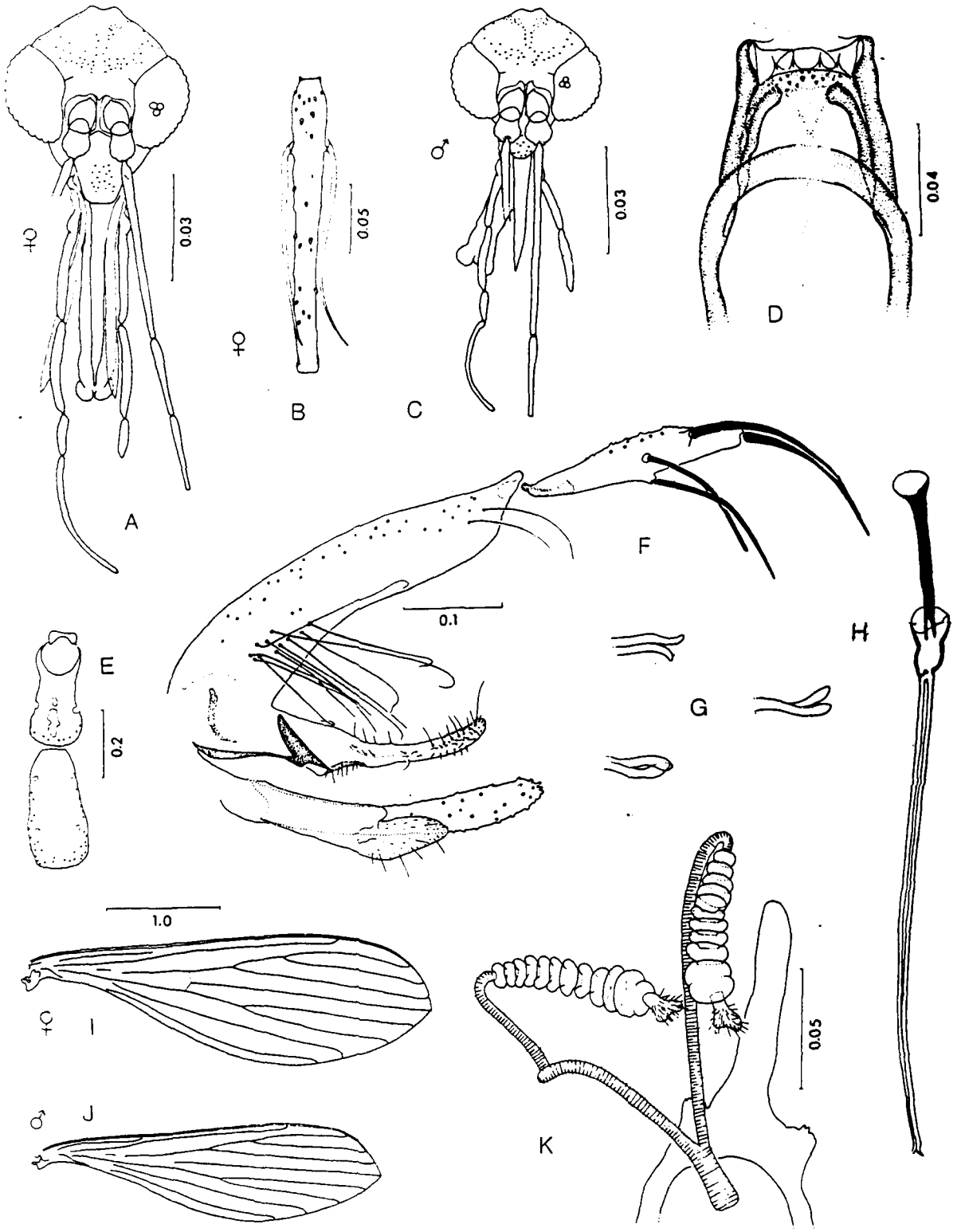



Plate 38-6

Lutzomyia ignacioi. A. Female head; B. Female flagellomere II; C. Male head; D. Female cibarium; E. First 3 sternites, male; F. Male terminalia; G. Tips of genital filaments; H. Genital pump & filaments; I. Female wing; J. Male wing; K. Spermathecae (from Young 1972a).

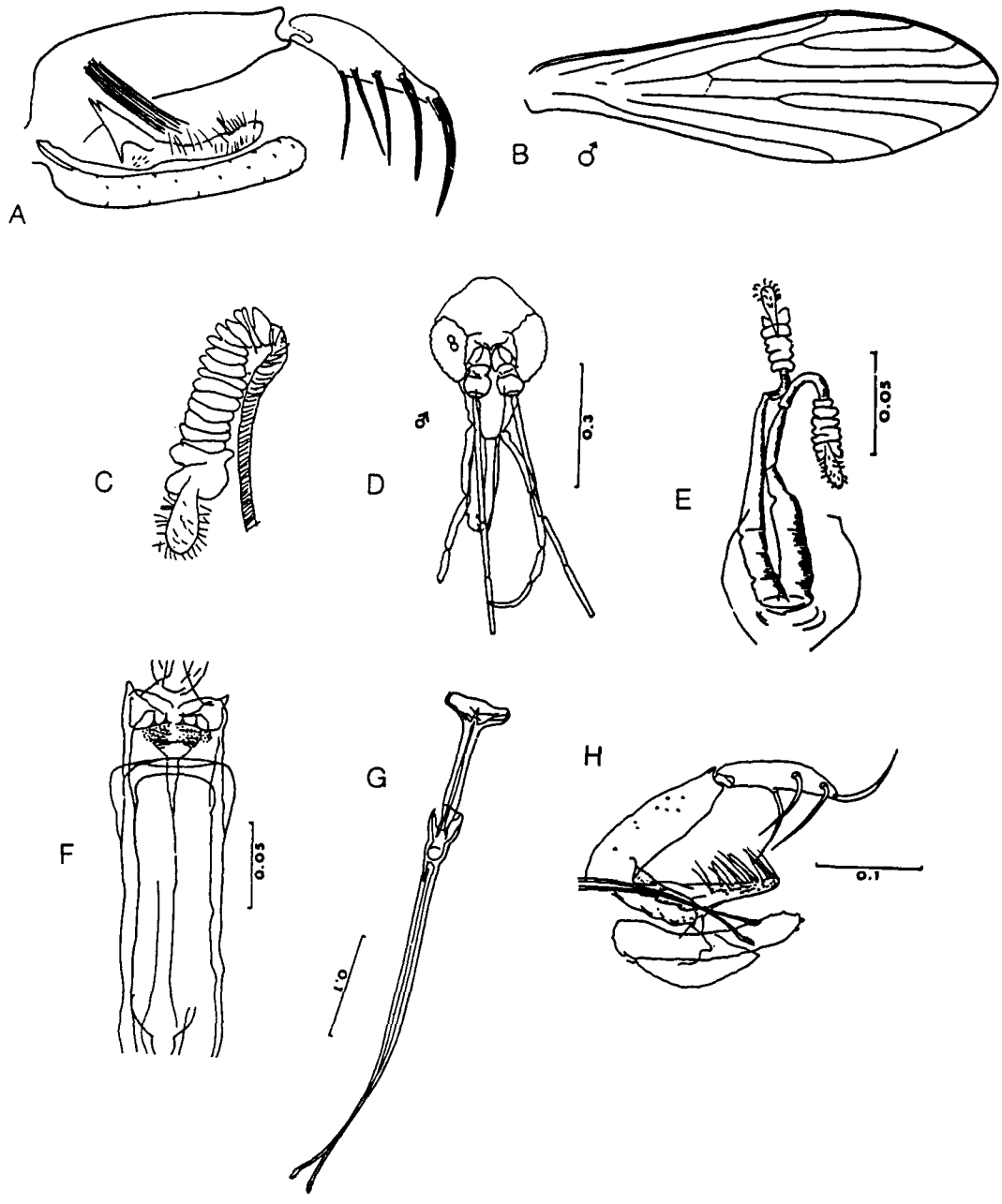



Plate 38-7

Lutzomyia torrealbai. A. Male terminalia; B. Male wing (from Martins et al. 1979b).

Lutzomyia ponsi. C. Spermathecae (from Laneti 1984).

Lutzomyia brisolai. D. Male head; E. Spermathecae; F. Female cibarium; G. Genital pump & filaments; H. Male terminalia (from Le Pont & Desjeux 1987b).

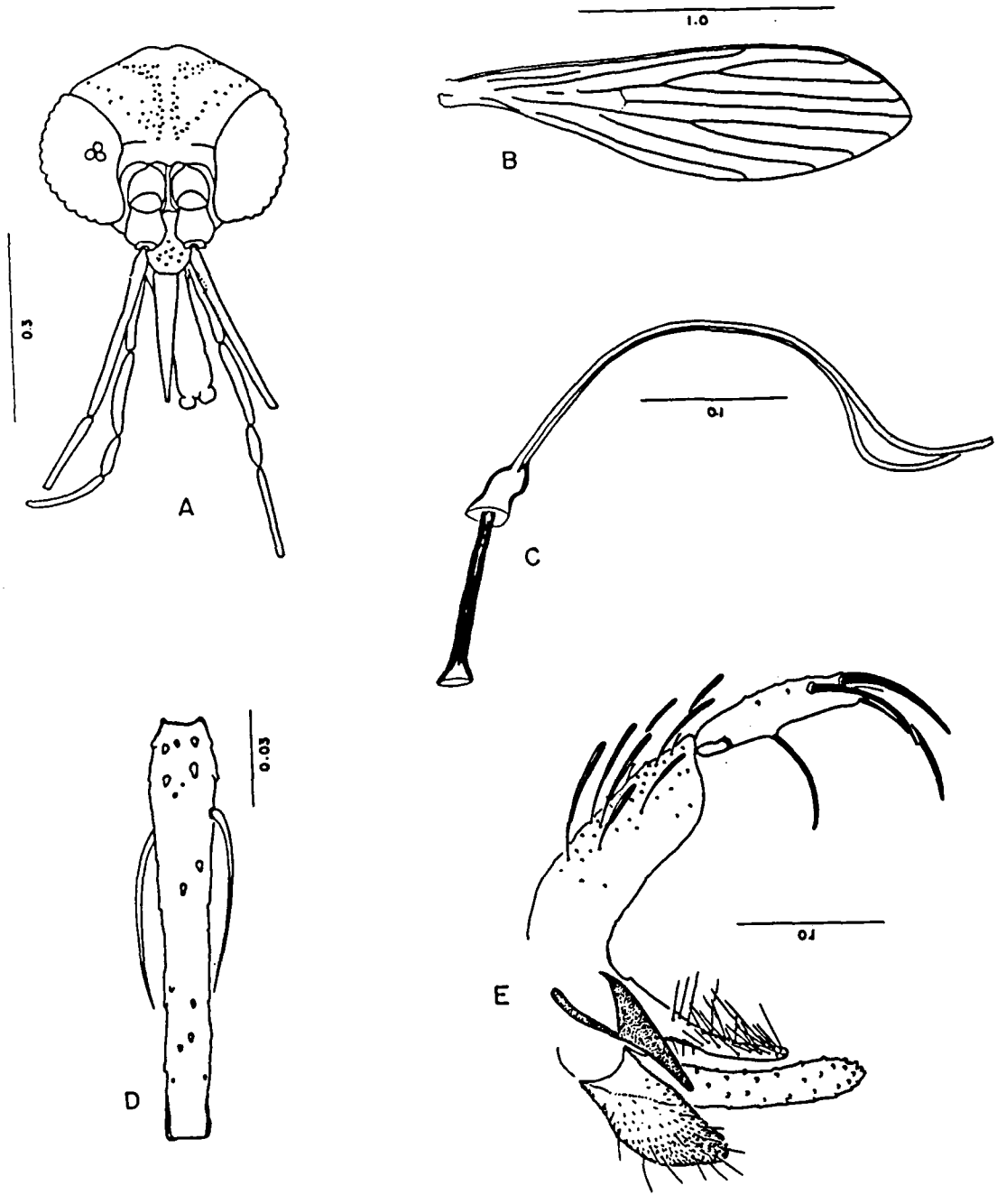



Plate 38- 8

Lutzomyia sp. of Anchicaya. A. Male head; B. Male wing; C. Genital pump & filaments; D. Flagellomere II ; E. Male terminalia; (from Young 1979).

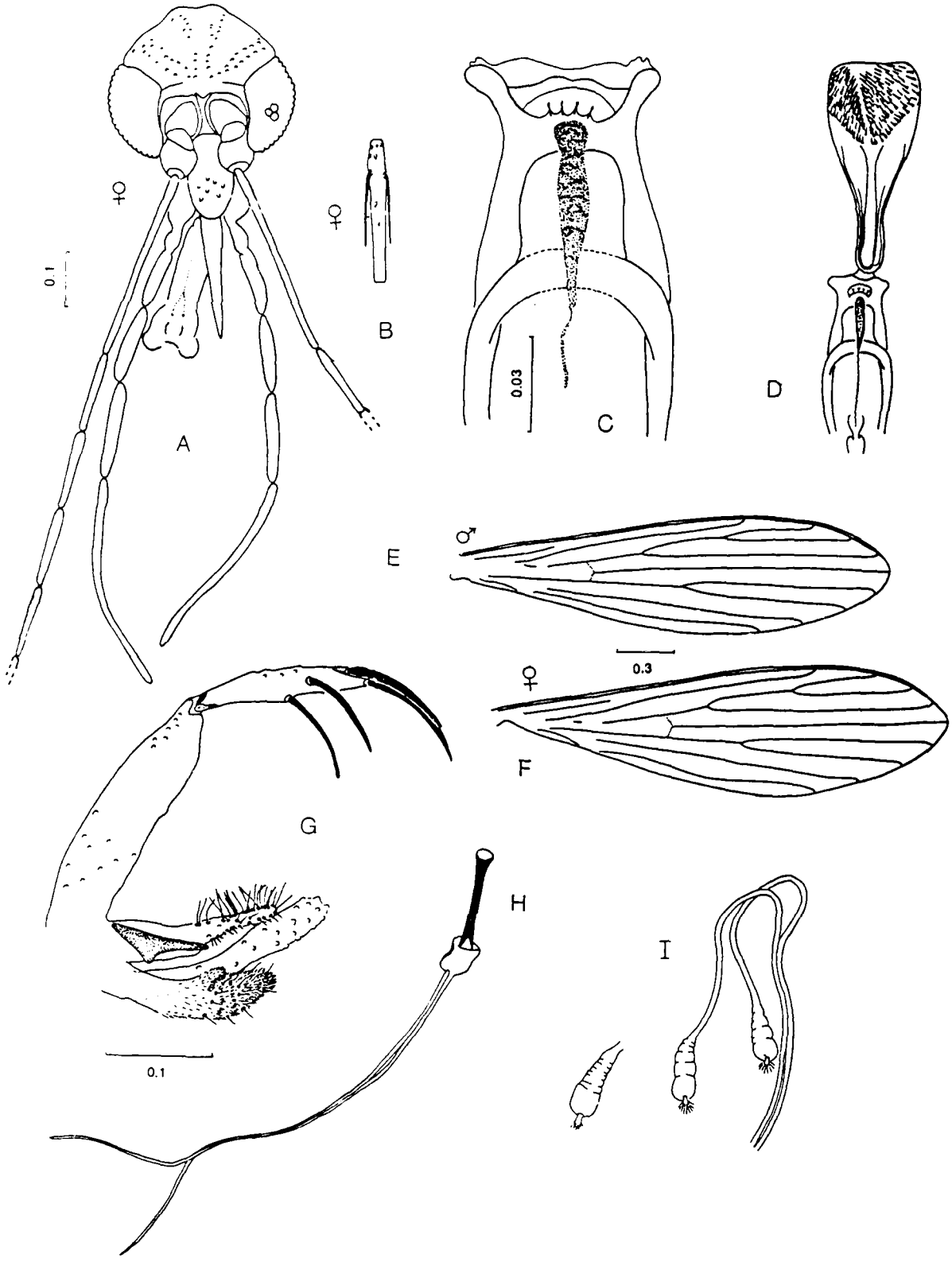



Plate 38-9

Lutzomyia acanthopharynx. A. Female head; B. Female flagellomere II; C. Female cibarium; D. Female cibarium & pharynx; E. Male wing; F. Female wing; G. Male terminalia; H. Genital pump & filaments; I. Spermathecae (fig. I. from Martins et al. 1962d).

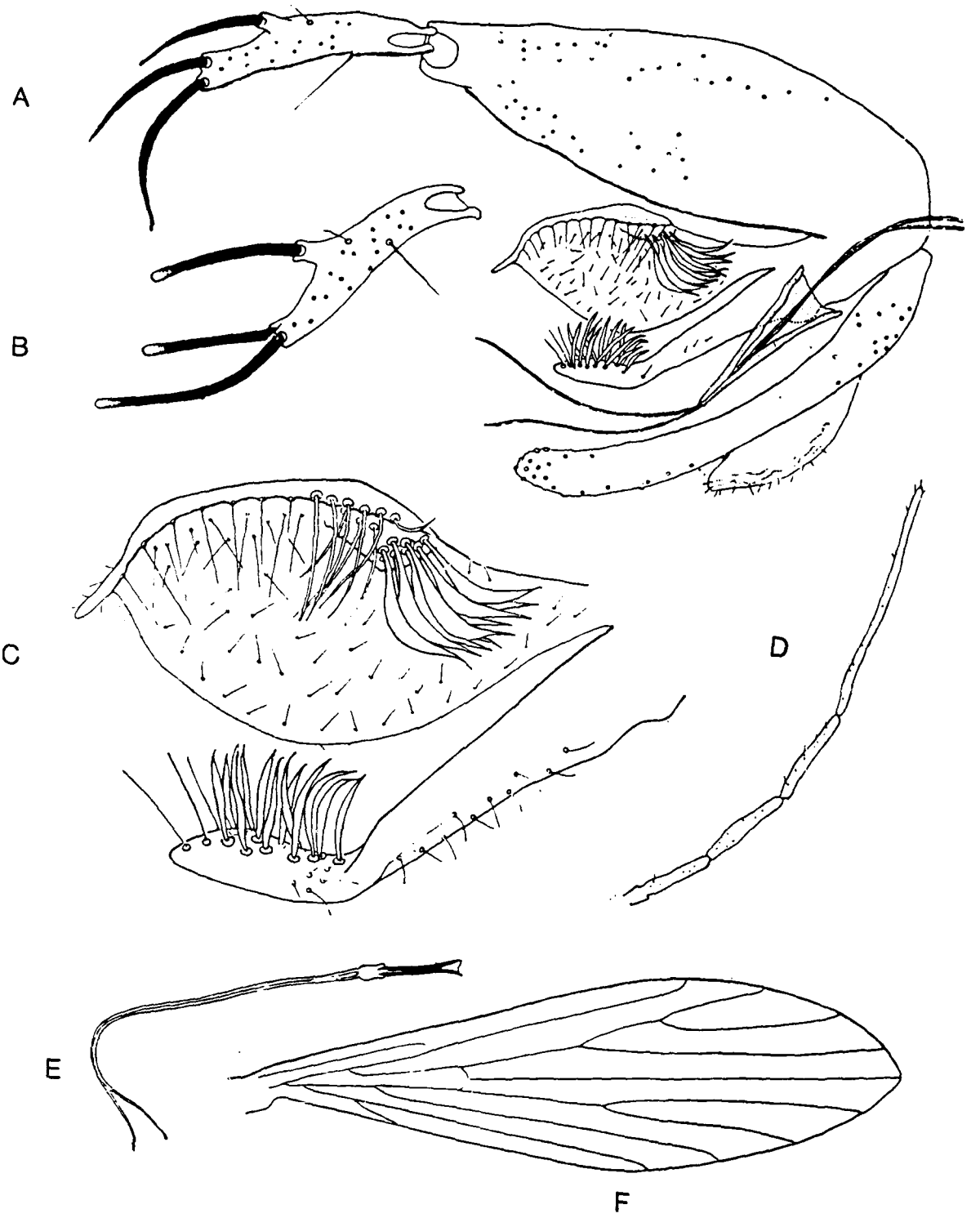



Plate 38-10

Lutzomyia samueli. A. Male terminalia; B. Style; C. Paramere; D. Palpus; E. Genital pump & filaments; F. Male wing (figs. from Deane 1955).

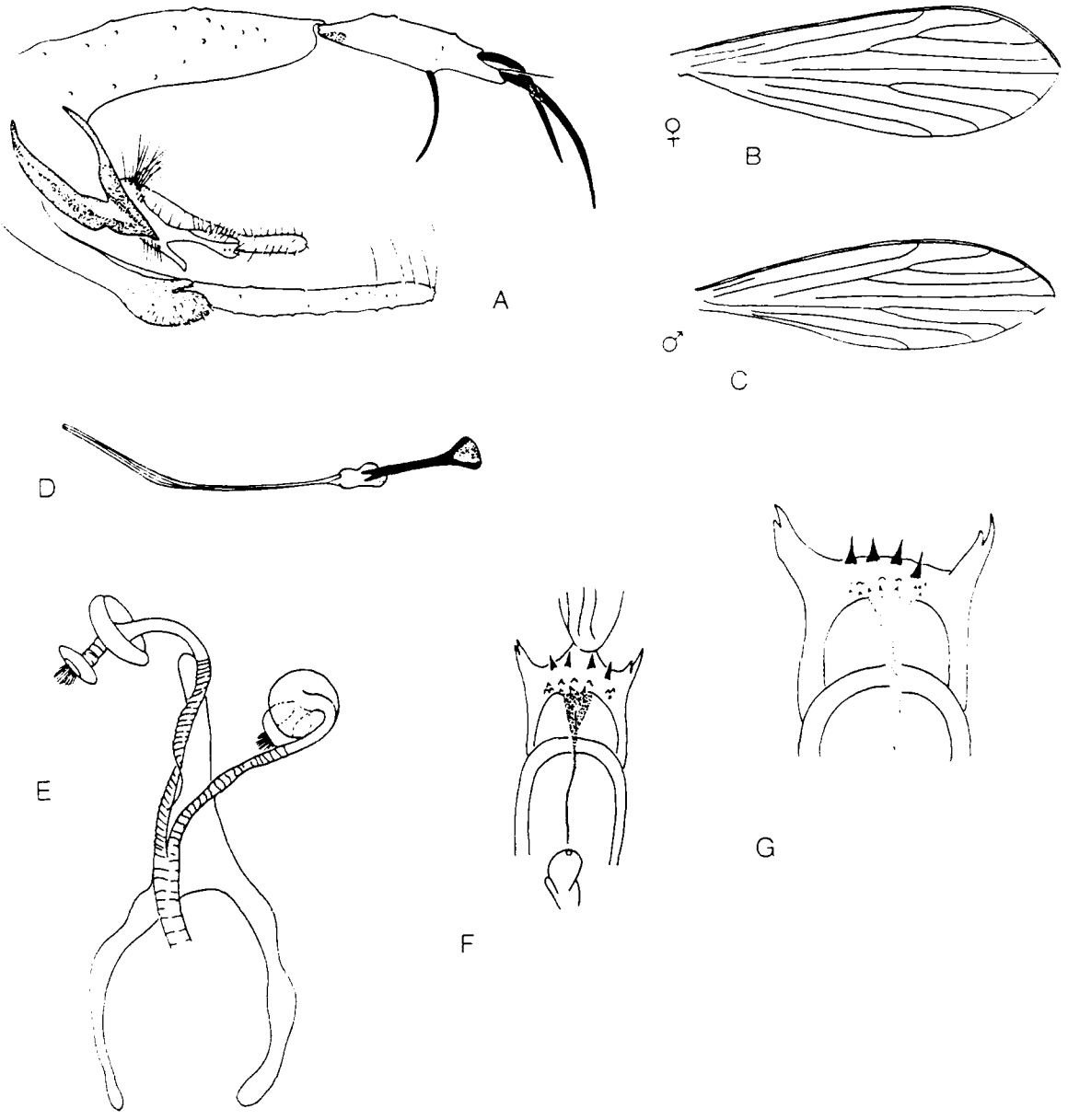



Plate 38-11

Lutzomyia boliviana. A. Male terminalia; B. Female wing; C. Male wing; D. Genital pump & filaments; E. Spermathecae; F. Female cibarium; G. Female cibarium; (figs. from Velasco & Trapido 1974).

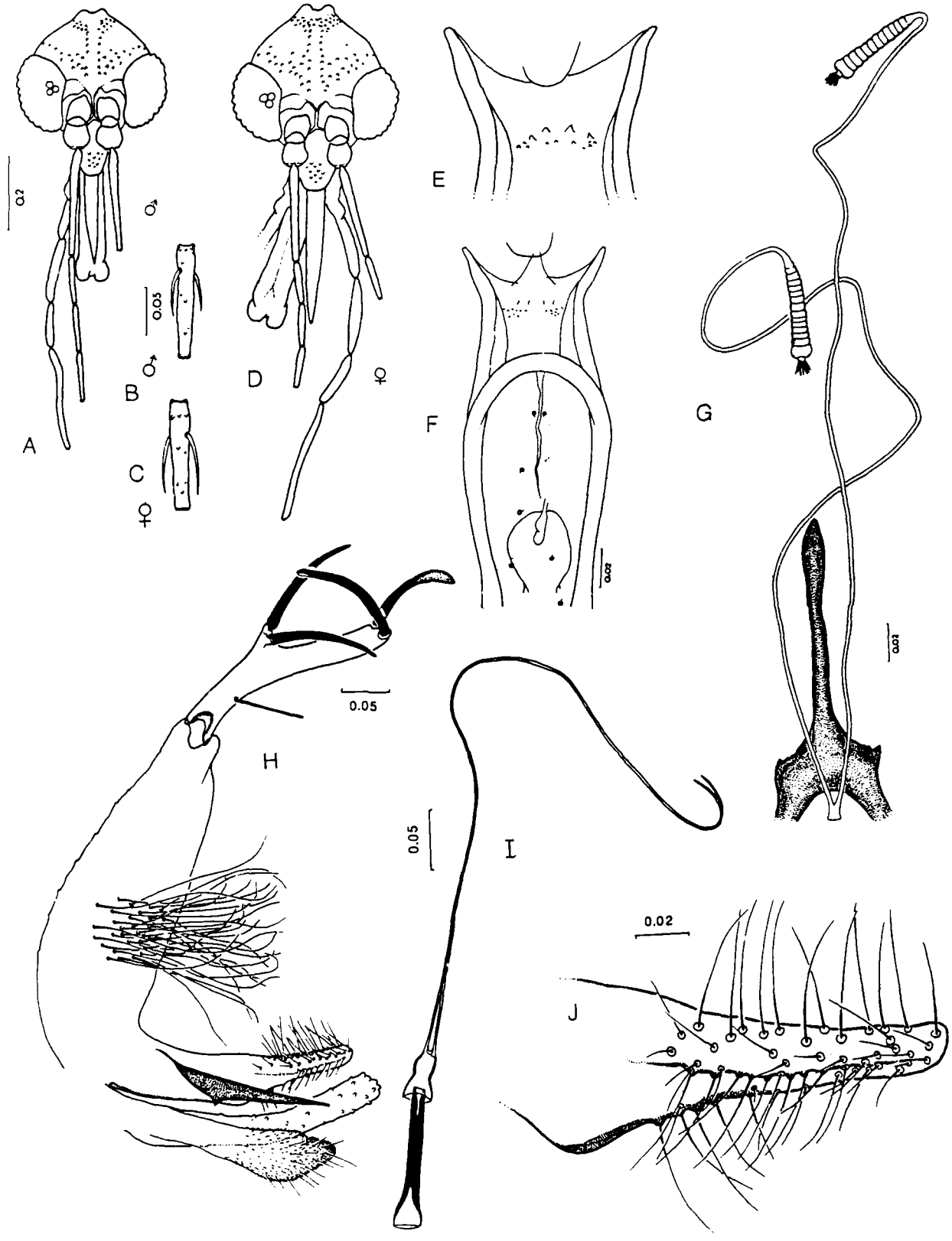



Plate 38-12

Lutzomyia oligodonta. A. Male head; B. Male flagellomere II; C. Female flagellomere II; D. Female head; E. Female cibarium; F. Female cibarium; G. Spermathecae; H. Male terminalia; I. Genital pump & filaments; J. Paramere (figs. from Young et al. 1985).

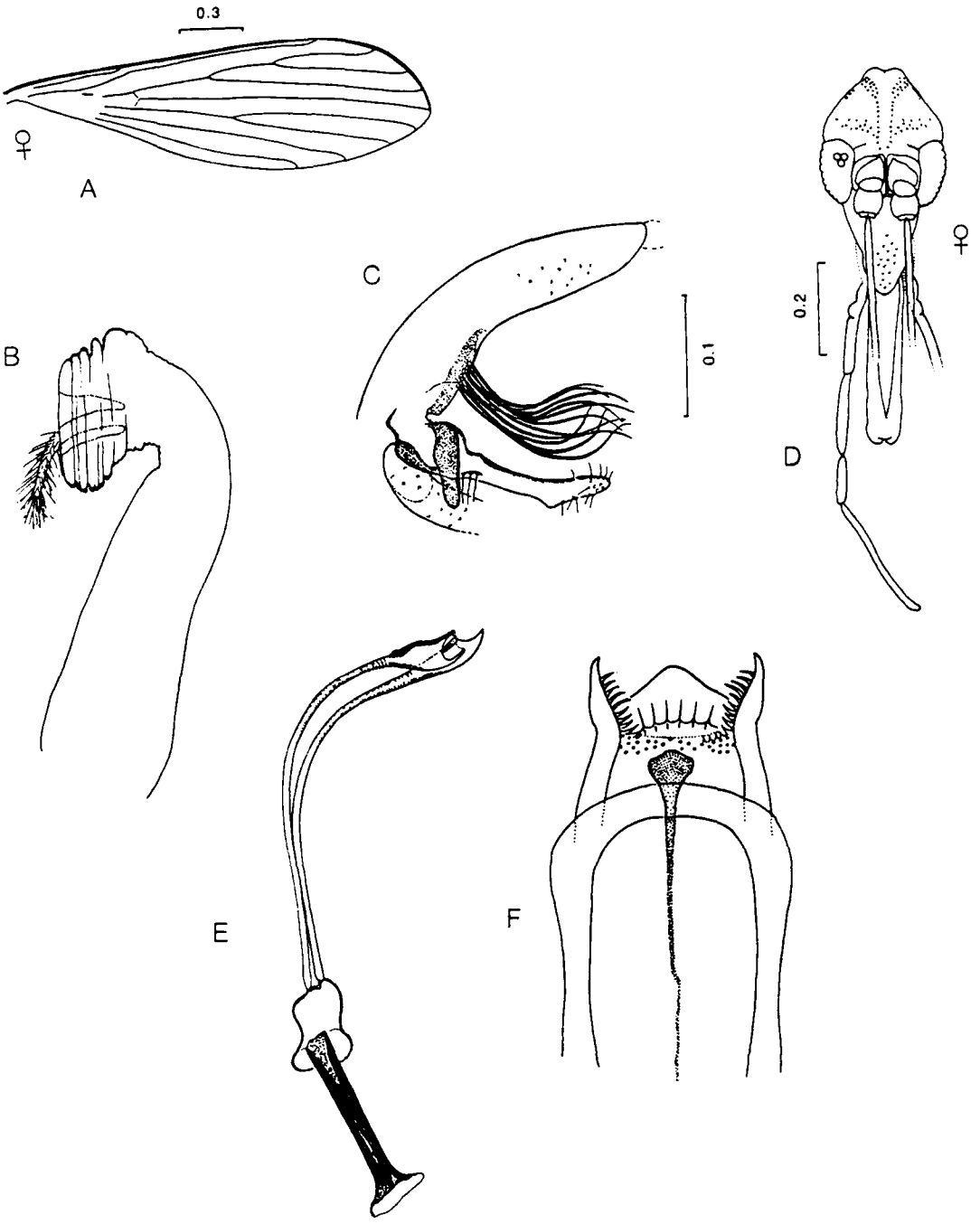
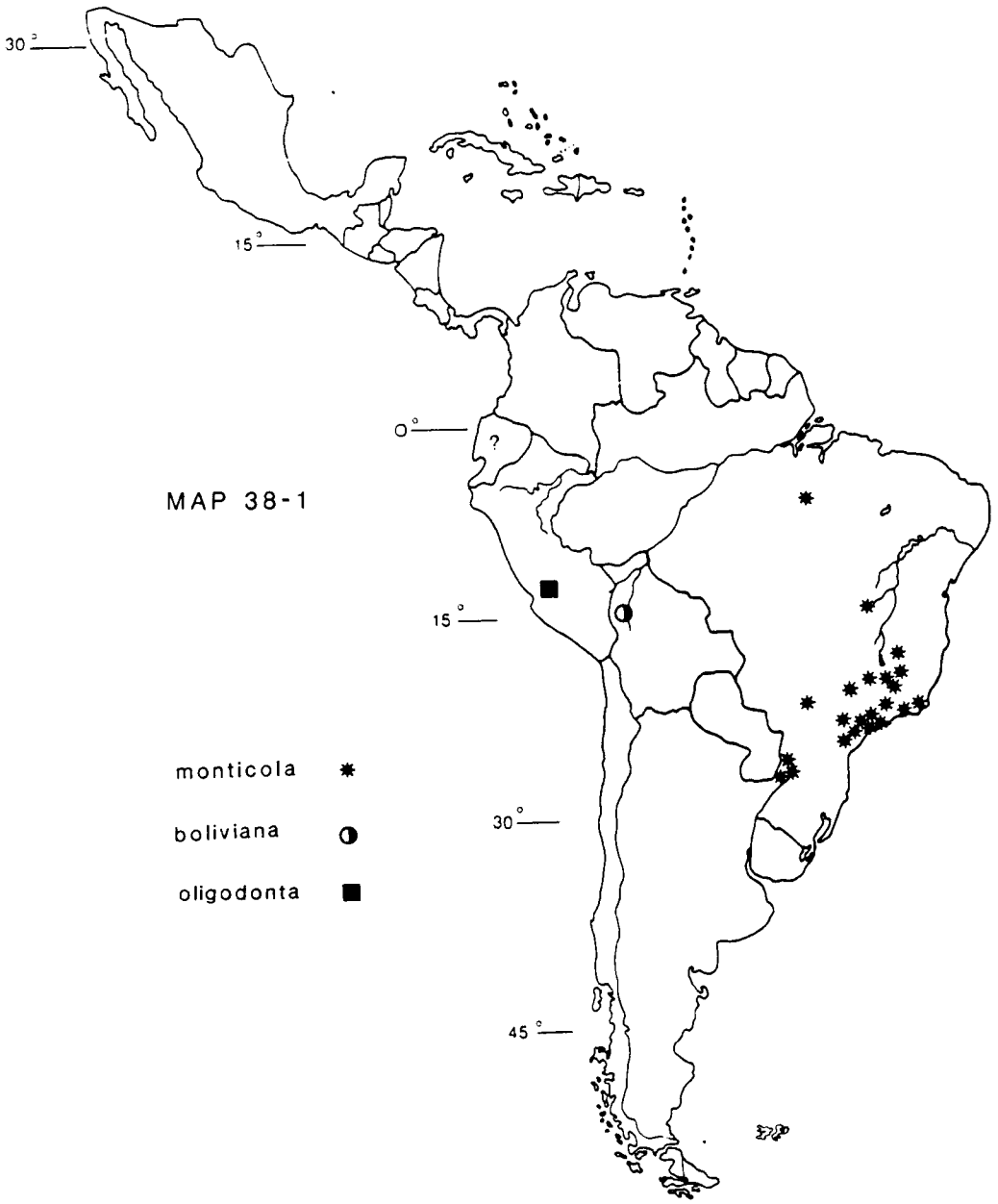



Plate 38-13

Lutzomyia (Ungrouped) n.sp. #1. A. Female wing; B. Spermathecae; C. Coxite & paramere (style & lateral lobe missing); D. Female head; E. Genital pump & filaments; F. Female cibarium.




MAP 38-1




MAP 38-2




MAP 38-3




MAP 38-4

pia ◑



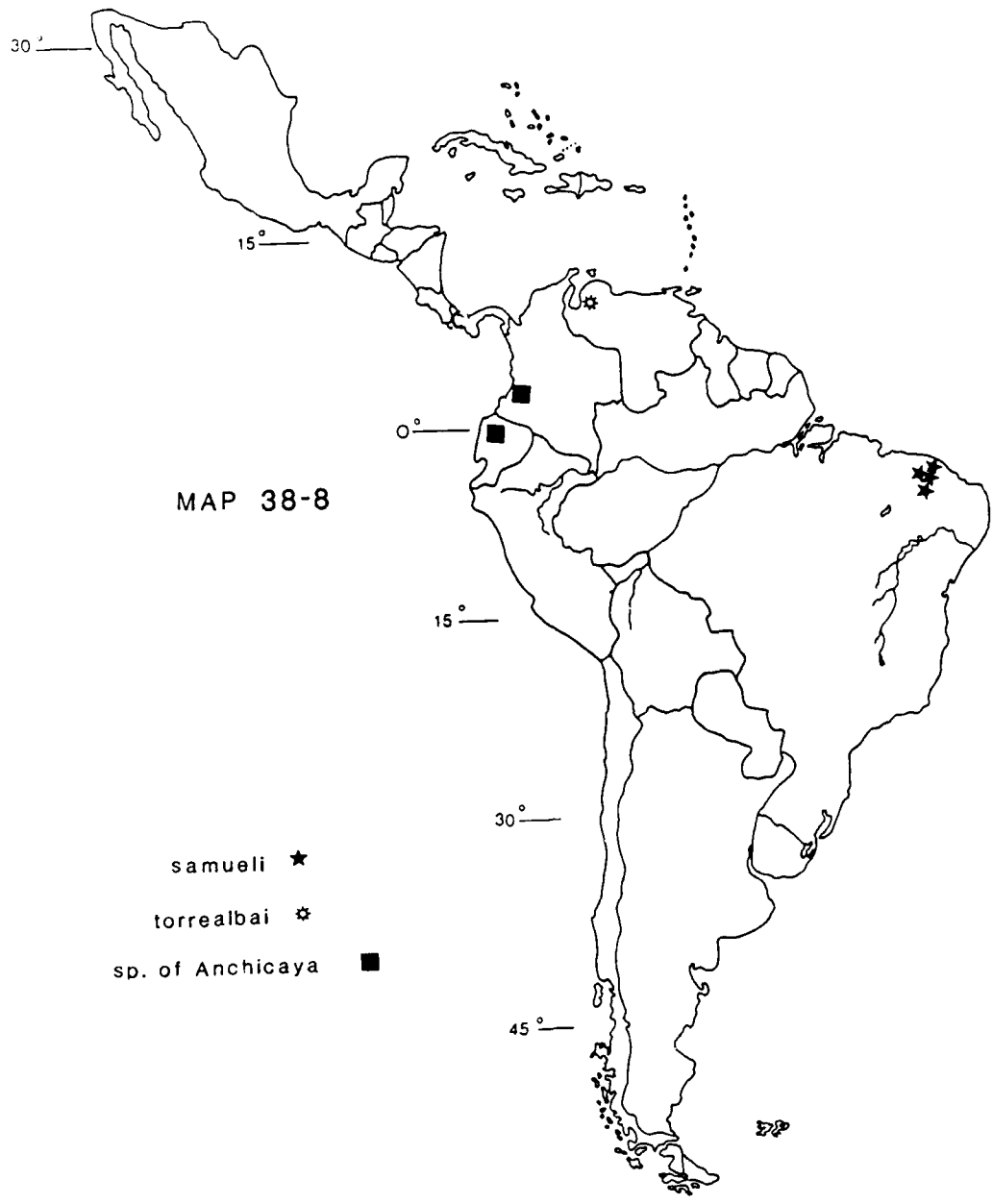

MAP 38-5

rangeliana




MAP 38-6


30°
15°
0°
15°
30°
45°
MAP 38-7
acanthopharynx
ponsi




MAP 38-8

## 39. Inadequately Described Lutzomyia Species

Several species included elsewhere in the text, such as L. fonsecai, L. ceferinoi, L. parimaensis, L. imperatrix, have not been fully described but their subgeneric or group status is determinable. In contrast, the identities of the two species in this section will remain a mystery, unless the type material is located.

### Lutzomyia maracayensis (Nunez-Tovar)

Plate 39-1

Phlebotomus maracayensis Nunez-Tovar 1924: 43 (Tucupido, Aragua, Venezuela). Forattini 1973: 358 (mention). Martins et al. 1978: 169 (listed).

Flebotomus maracayensis: Barretto 1947a: 210 (refs.).

Lutzomyia maracayensis: Theodor 1965: 196 (listed). Feliciangeli 1980: 263 (♂ fig.).

Distribution (Map 39-1). Venezuela (type locality).

Remarks. This species is unrecognizable; the types consisted of two males (Costa Lima 1932), but these have been lost or destroyed for decades.

## Lutzomyia singularis (Costa Lima)

Plate 39-1

Phlebotomus singularis Costa Lima 1932: 50 (♀, Juqueri, São Paulo, Brazil). Forattini 1973: 358 (listed). Martins et al. 1978: 169 (listed).

Flebotomus singularis: Barretto 1947a: 223 (refs.).

Lutzomyia singularis: Theodor 1965: 196 (listed).

Distribution (Map 39-1). Brazil (type locality).

Remarks. The original, inadequate description of L. singularis was based on a damaged female, the spermathecae of which resemble L. intermedia. Apparently, two females were examined by Costa Lima (1932). They may have been housed in the collection of the Instituto Oswaldo Cruz, Rio de Janeiro, but it is not known if they still exist.

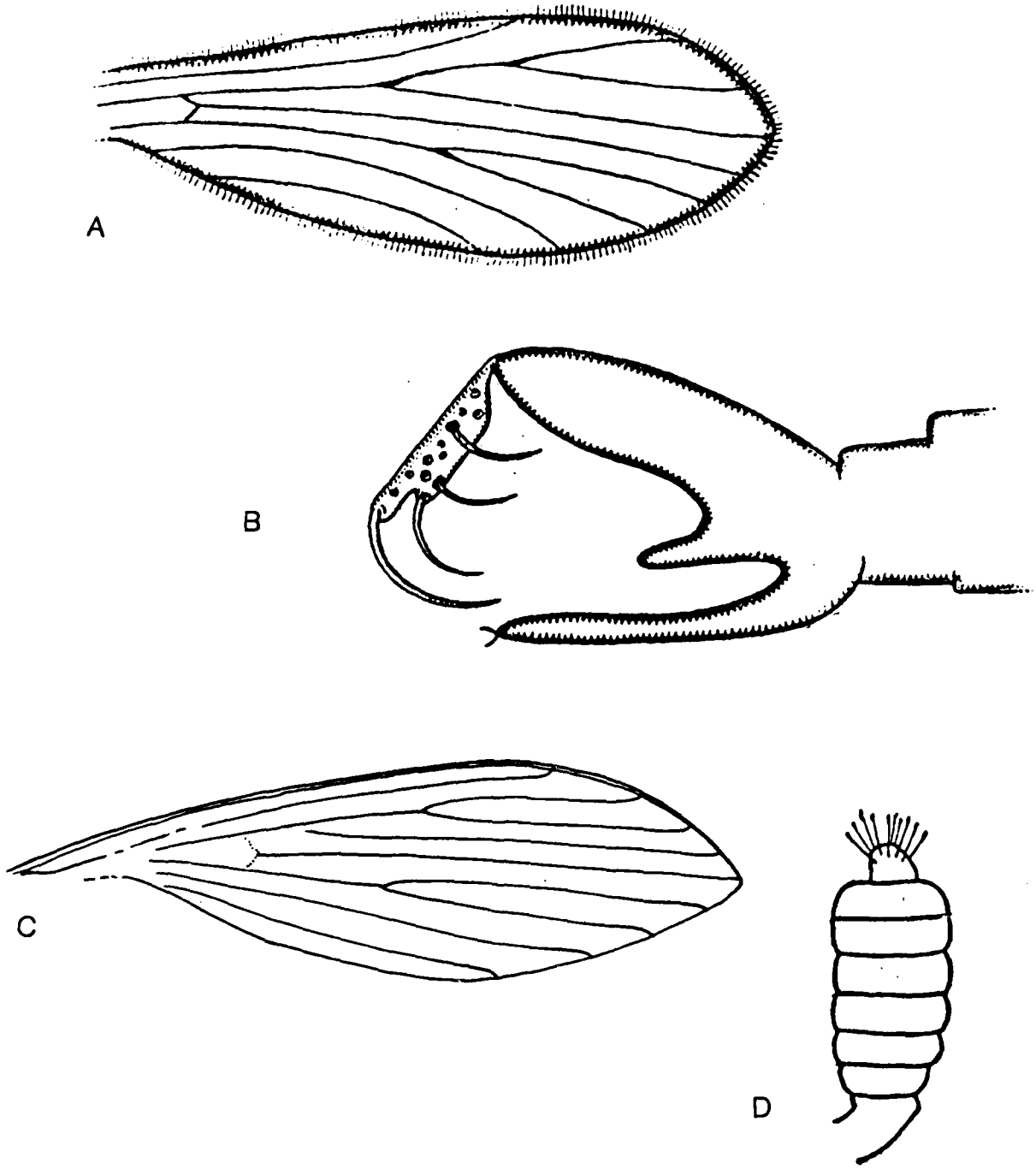



Plate 39-1

Lutzomyia maracayensis. A. Male wing; B. Male terminalia (figs. from Nunez-Tovar 1924).

Lutzomyia singularis. C. Female wing; D. Spermatheca (figs. from Costa Lima 1932).




MAP 39-1

# PART VII

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PART VIII

SYSTEMATIC INDEX

Names of genera (upper case), subgenera and equivalent species groups (lower case are listed at the far left; those of species and subspecies are indented under the genus in which they are placed (mostly Lutzomyia). Trivial names considered to be junior synonyms or homonyms are italicized.

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*Not all of the informally named species are included in this review. Some are junior synonyms of other species or are inadequately known (see Martins et al. 1978 for additional names).

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